WORLD PETROLEUM

July 15, 1958

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TWENTY-EIGHTH ANNUAL REFINERY REVIEW

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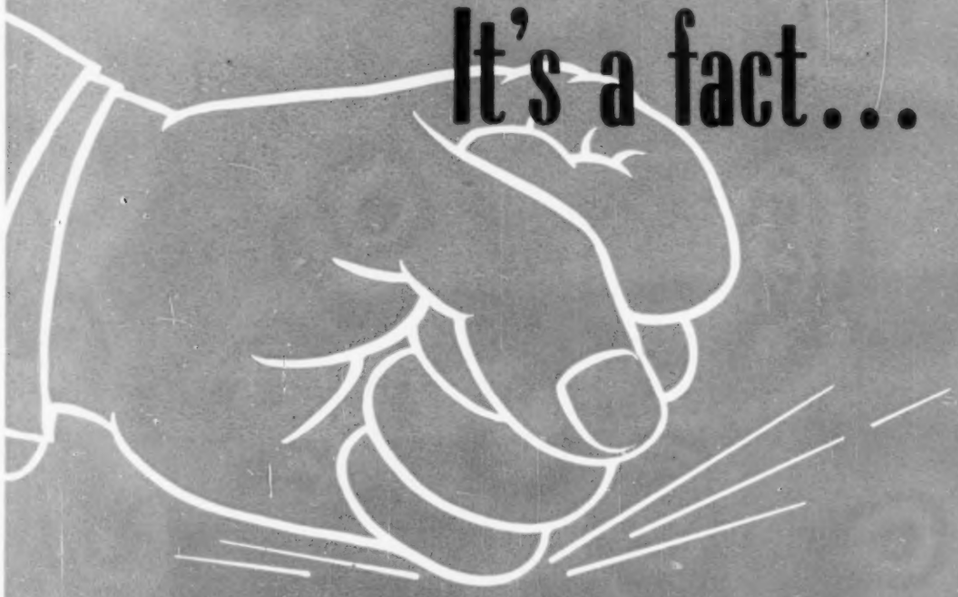

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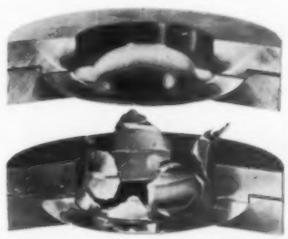

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World Petroleum

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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THIS MONTH'S COVER

Is a night view of The Grangemouth, England, plant of British Hydrocarbon Chemicals Ltd., owned 50% by British Petroleum Ltd. and 50% by The Distillers Co. Its capacity will be nearly 200,000 tons yearly of various chemicals when additions now under way are completed during 1959. About $22 million in facilities is being added, including a phenol and acetone plant, the first of its kind in the United Kingdom.

Washington PIPE LINE

by Joseph B. Huttlinger

More Import Controls

Failure of Congress to enact mandatory controls on foreign-oil imports as an amendment to the reciprocal-trade-agreement-act extension bill means the Eisenhower Administration is faced with the task of interpretating compromises agreed upon during the long trade-bill fight in Congress. What the administration will do with the amendment adopted to the national-security provision of the 1955 act—designed to require the President to consider various criteria, including loss of investment, in determining whether excessive foreign imports of oil and other minerals are threatening the national security—remains to be decided.

The administration agreed to this amendment when the bill passed the House, but did not explain just what would be done once the provision became law. While some administration officials believe it will mean a tightening of the voluntary oil-import allocations, there has been no positive indication by the White House that this will be the result.

Meanwhile, Captain Matthew Carson, Jr., administrator of the voluntary import-control program, is expected to announce details of administration of the controls imposed upon imports of "unfinished gasoline" and "unfinished oils." Announcement of expansion of the voluntary program to include these products was made shortly before the House voted on the trade bill, but caught the administrator short. As a result, he has been forced to hold up issuance of regulations and details pending a lengthy administrative and legal study. Captain Carson believes a formal announcement should be forthcoming shortly, and the added controls can get under way probably, August 1.

Antitrust Skirmishes Begin

The 29 USA oil companies indicted, May 29, on a general charge of crude-oil and gasoline price fixing in January 1957, have been given a deadline of August 1 to file preliminary motions, such as for dismissal of the entire case. US District Judge Albert V. Bryan at Alexandria, Va., also set September 10 for arguments on those motions. Judge Bryan was to hear arguments, beginning July 10, on a government motion to impound thousands of documents submitted by companies to the federal grand jury which returned the indictment. Joseph E. McDowell, of the antitrust staff of the Department of Justice, said he will return some of the documents as rapidly as he can, but needs others in trial of the case.

Up to 100 lawyers will be representing the companies in the case, but with no overall lawyer for all, it was explained by Edward F. Howrey, counsel for Socony Mobil Oil Co. and Magnolia Petroleum Co. The case is one of the strangest in recent antitrust history; because the indictment is so vague, it caught the Department of Justice by surprise. It was followed in two days by the resignation, voluntarily, of government attorney on the case, Worth Rowley, chief of the trial section; and it came on the last working day in the 18-month life of the grand jury.

Higher Alaskan Rentals

Chances are it will cost more to own an oil or gas lease in Alaska. Interior Secretary Seaton, pressed by Senate leaders, suspended issuance of oil and gas leases in parts of Alaska in May, for a study of whether the rentals should be doubled to 50¢ an acre. He later told Senate Interior Committee he would not object to legislation hiking the rentals to 50¢.

Suspension held up final action on application to lease: (1) about one million acres in the Kenai Moose range, (2) about four million acres in Public Land Order 82 area—next to Naval Petroleum Reserve No. 4, (3) 16,000 acres in Gubik area near Fairbanks; (4) 14 million acres in Alaska outside the Kenai, Order 82, and Gubik areas.

Another 12 million acres of public lands in Alaska has been leased out at the 25¢ figure; and these are not touched by the suspension or prospection legislation. States of the USA receive 50¢.

Gas Lines Get Go-Ahead

In a Supreme Court ruling that it is proper for the government to approve a natural-gas pipeline, even though someone is hurt by competition from the new gas supply, fuel-oil dealers faced competition. The high court thus cleared the major hurdle for two related companies to construct 1,500 miles of main line and 1,000 miles of laterals from Texas to Miami, Fla., at estimated cost of $150 million.

Coastal Transmission Corp. is to lay a gas line to Baton Rouge, La., and Houston Texas Gas & Oil Corp. a continuation from Baton Rouge to Miami. Industries, electric plants, and local distribution companies are to buy the gas.

FPC approved the project, December 28, 1956; then an association of fuel-oil dealers, Florida Economic Advisory Council, appealed to the courts—complaining a loss of business by members of $20 million a year. The appeal claimed the FPC did not give sufficient consideration to all angles. The Supreme Court refused to hear the fuel-oil dealers complaint.

Bright Future For Gas

USA natural-gas industry faces "bright" future of expansion, according to FPC Frederick Stueck, who pooh poohs atomic energy as competition in the energy market for years and decades ahead. Yet, he says, the industry has a major problem in the peaks and valleys of demand, with high winter loads due to heating demand, and then "summer valleys." Storage pools have been built to meet the peaks and valleys. Ultimate solution, he feels, is for gas industry to develop a competitively-priced gas-powered heat pump, which can heat a home in winter and cool it in summer. There are 50 or so such units in, for instance, Dallas, Texas, where the cooling demands are greater than the heating demands for gas. Yet, he sees need for a better and cheaper unit to compete with electric pumps, which are "making inroads" on oil and gas heating sales.

Perennial Depletion Attack

The running attacks on the 27.5% income tax depletion provision for crude-oil and natural-gas production are likely to erupt into debate on the Senate floor before this session of Congress ends in August. Senator Paul Douglas (D., Ill.) said he would propose a measure to allow the 27.5% rate only to operators with less than $1 million of gross income per year from oil and gas—with 21% from $1 to $5 million, and 15% over $5 million.

Senator John Williams (R., Del.) meanwhile has been arming himself with ammunition to join Douglas in an assault on the allowance when the proper time comes. Finally, the Oil Workers International Union has come out for an allowance only to oil and gas operations in the USA, but to deny it to foreign operations.

Eisenhower administration, which has indicated 27.5% is about right both in this country and abroad, has given a fresh sign it will fight for this.

To Promote USA Jobs

A complete shift has taken place in arguments in behalf of USA program of foreign aid of some three to four billion dollars a year to friendly foreign nations.

After World War II, the arguments were that program is needed to help Europe get on its economic feet; USA is wealthy enough to finance program to send dollars and materials to Europe. Now, a major argument of Eisenhower administration is that program is needed for these reasons, but also to bolster USA economy. Jobs for Americans are at stake, it is claimed. Bluntest statement came in a report of National Planning Assn. to International Cooperation Administration—USA agency running foreign-aid programs—that 714,600 Americans hold jobs due to demands created by the foreign-aid program. Further, some 4,230 of these jobs are in the oil industry.

Which Agency For Gas?

Legal question as to whether Department of Justice or Federal Power Commission is controlling agency is posed by second DJ action aimed at natural-gas companies. First came in DJ suit to undo merger of El Paso Natural Gas Co. which bought up Pacific Northwest Pipeline Corp.—with action in the courts still pending. Second sought and obtained indictment against American Natural Gas Co., Northern Natural Gas Co., and People's Gas Light & Coke Co. seeking to restrain them against alleged blocking of others who may wish to bring gas into Midwest area. Among newcomers is Tennessee Gas Transmission. Companies involved are confident DJ has no jurisdiction because their actions are all under proceedings of US Federal Power Commission.

FPC Appointment

President Eisenhower has appointed John B. Hussey, conservation commissioner in Louisiana, a member of the US Federal Power Commission, succeeding Seaborn L. Digby, resigned as of June 22. Both have urged removal of federal controls over gas production.

Less Benefits From Depletion

Oil and gas producers seeking more benefits from 27.5% depletion allowance face this ruling of Internal Revenue Service: "Intangible drilling and development costs incurred in drilling nonproductive wells in the development of the same producing deposit or reservoir must be deducted in computing taxable income from the producing property for the purposes of the limitation on percentage depletion.

"However, such costs incurred in an attempt to penetrate an entirely different and separate reservoir horizon from the known producing zone

(Continued on page 149)

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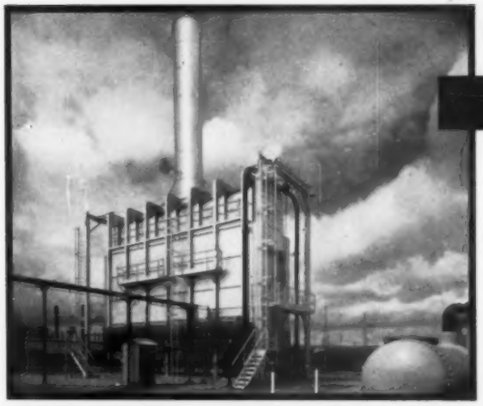

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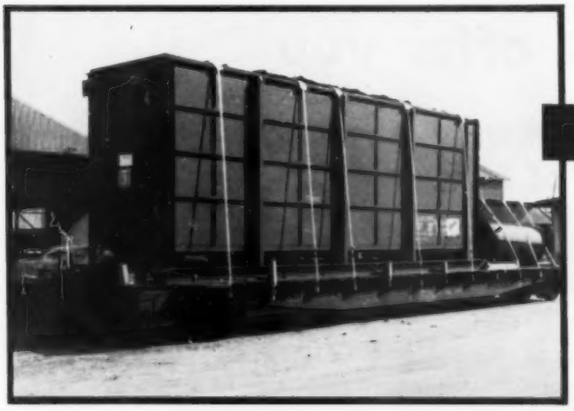

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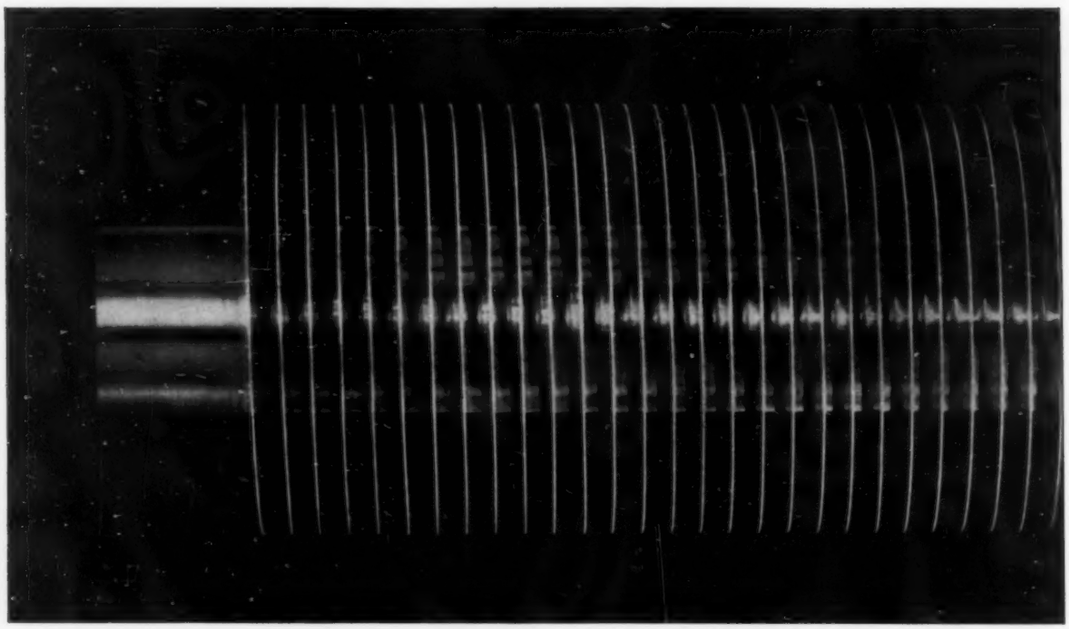

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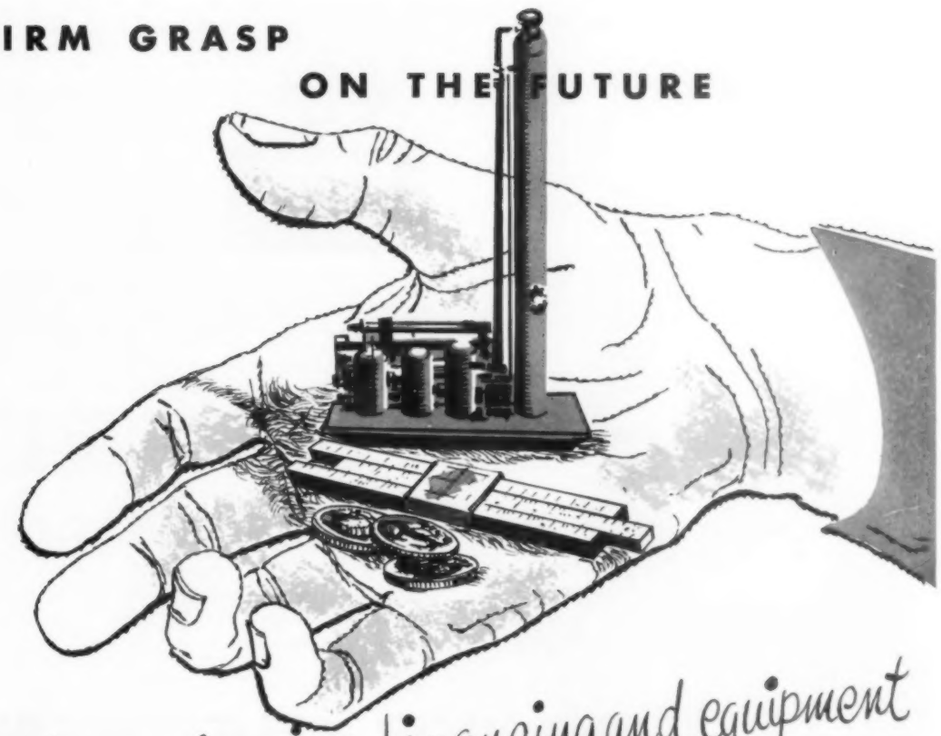

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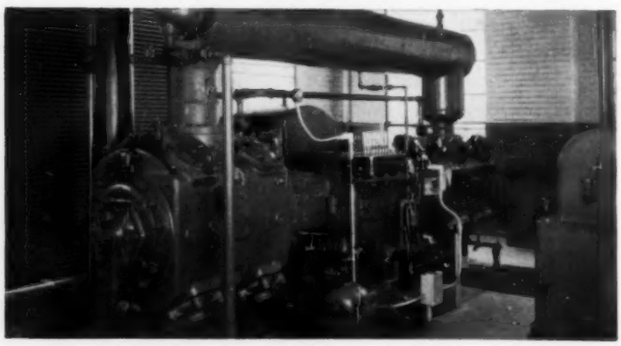

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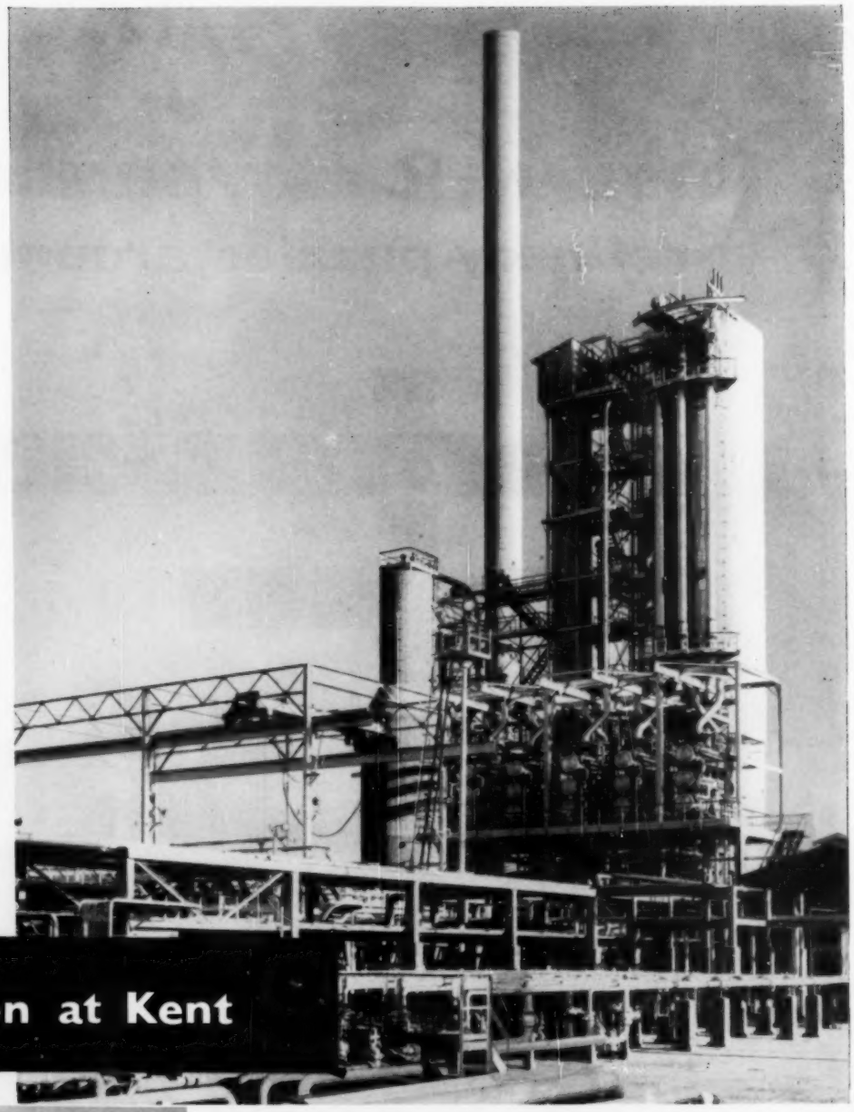

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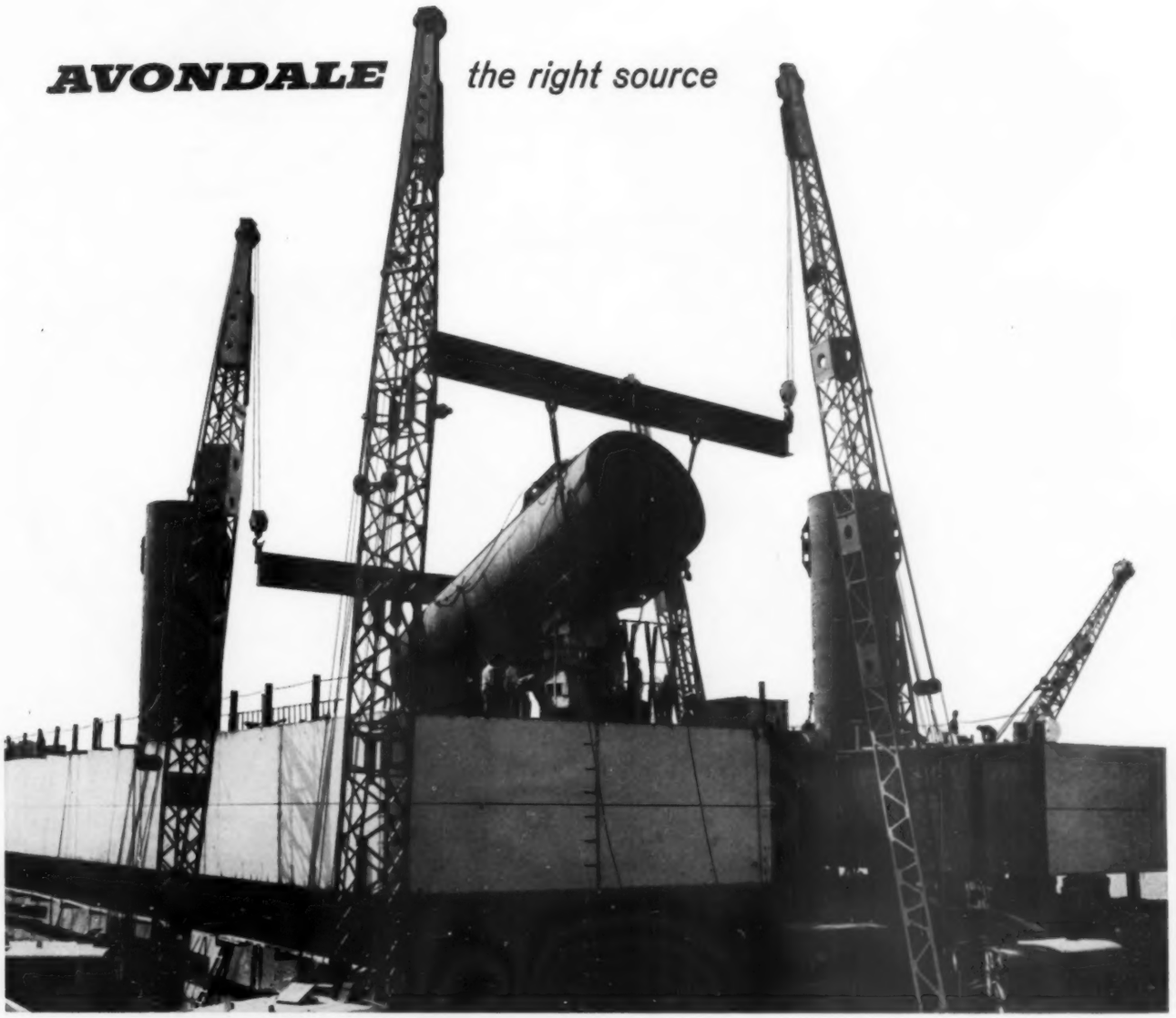

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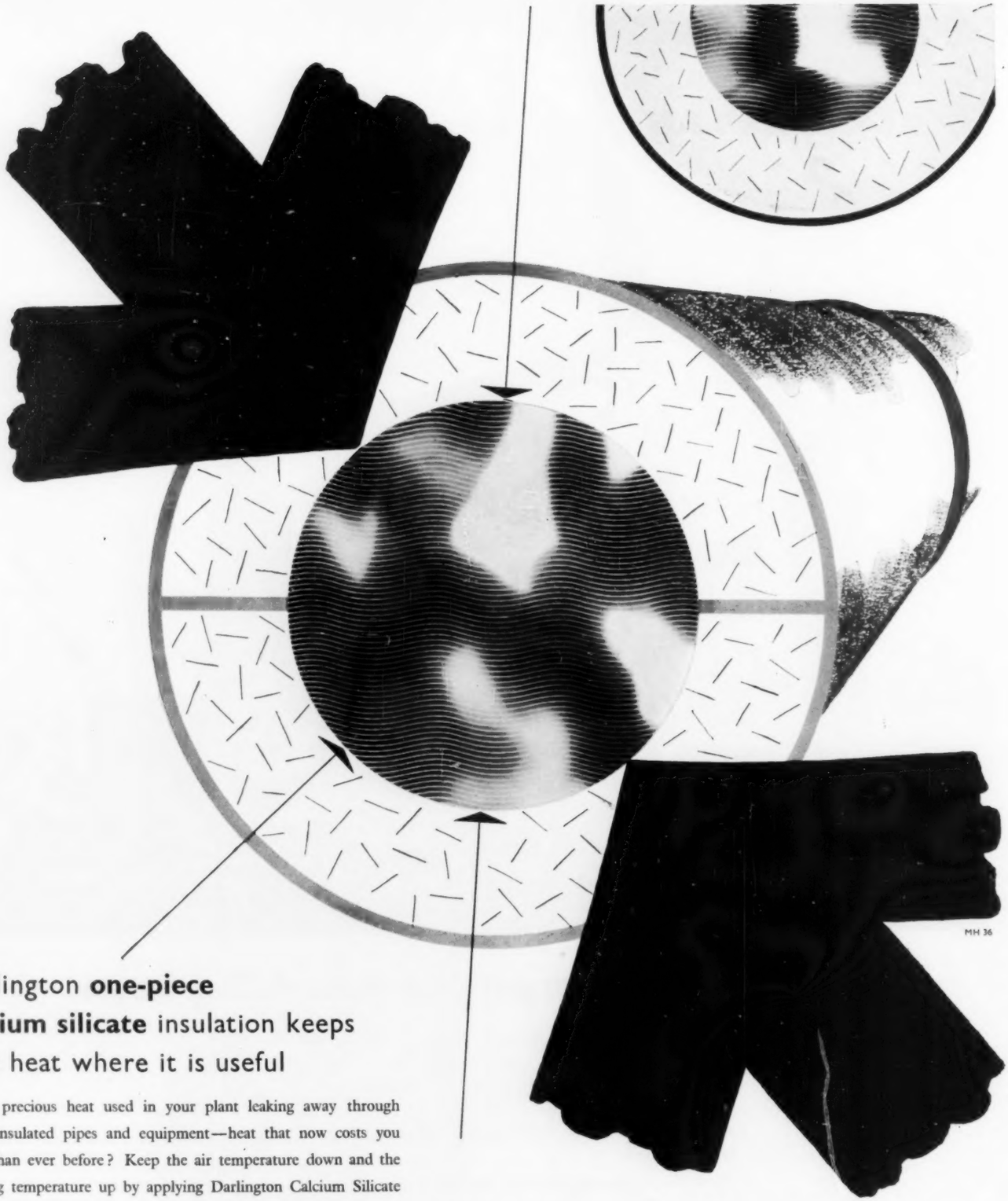

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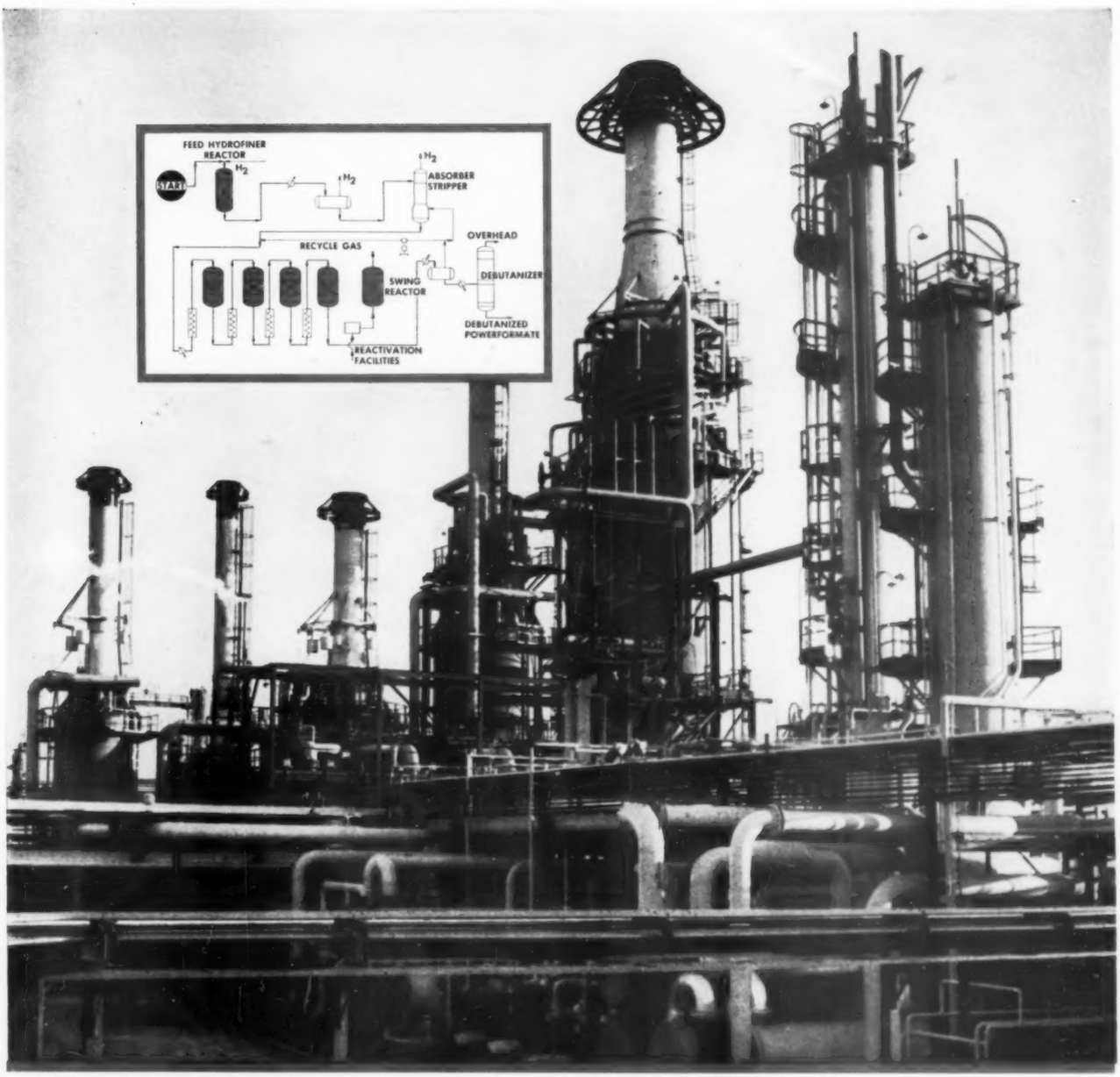

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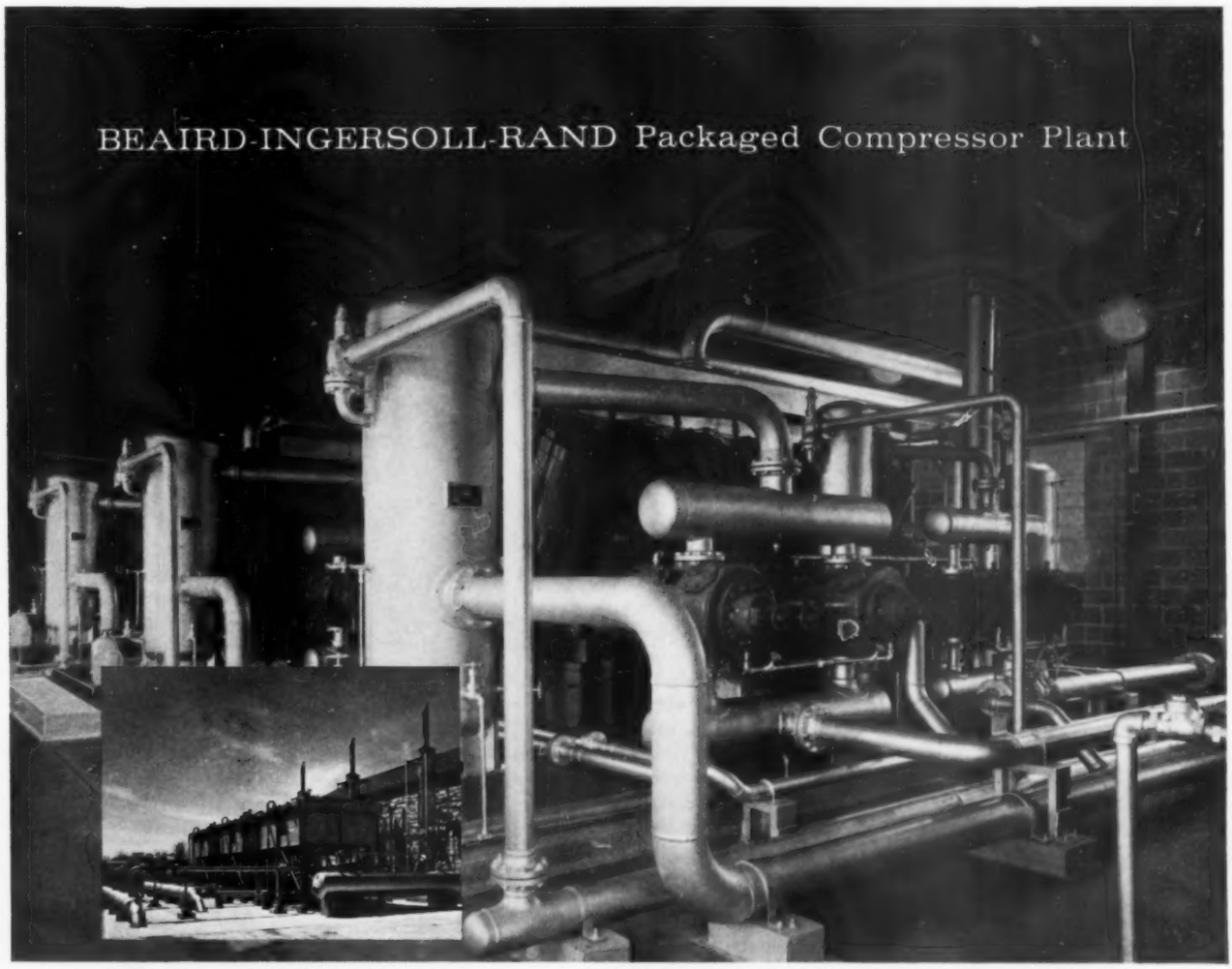

Horizontal radiators are cooled by hydraulic motor driven fans powered by pumps V-belted to sheaves on the end of each engine crankshaft.

Laclede Gas Company's Gas Storage Project—equipped with three Beaird-Ingersoll-Rand 660 h.p. 12SVG packaged compressors. Units have Young radiators with gas, lubricating oil and engine water cooling sections. Other Beaird compressors from 120 to 660 h.p.

PACKAGED COMPRESSORS STORE WINTER'S RESERVE GAS SUPPLY FOR ST. LOUIS

LOWEST COST PER HORSEPOWER INSTALLED

BEAIRD
another AMF product
PACKAGED COMPRESSOR PLANTS

Packaged Compressors are just one of the many products manufactured by Beaird for the petroleum and petrochemical industries. When you are in the market for new equipment or assistance in developing a specialized product . . . contact Beaird for a qualified appraisal or quotation.

IN ONE of the largest and most successful projects of its type, Laclede Gas Company of St. Louis is pumping billions of cubic feet of natural gas into sandstone that never held gas before. This additional supply will meet peak load demands enabling the company to heat additional thousands of St. Louis homes this winter.

Three Beaird-Ingersoll-Rand 660 h.p. 12SVG packaged compressors are taking up to 16 MMcfd, delivered by pipeline from Louisiana, compressing it through two stages from 50 to 125 psi. suction to 655 psi. discharge. The gas is injected down 1400-1500 foot wells into a natural sandstone reservoir bed.

Gas interstage and after cooling is provided in sections of the horizontal radiators mounted outside the compressor building. Use of electric motors to drive auxiliary equipment has been eliminated wherever possible. Pumps for engine cooling water, lubricating oil and radiator hydraulic fan motors are all driven off the compressor.

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana

A Subsidiary of American Machine & Foundry Company

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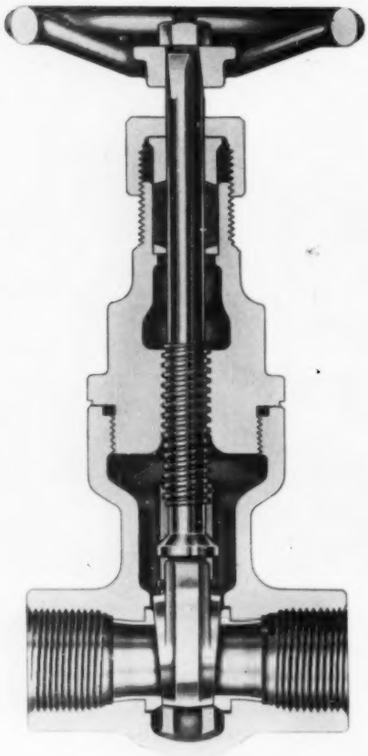
Let PACIFIC prove to you ...greater valve effeciency



PACIFIC'S FIGURE NO. S555
150 lb. Stainless Steel Gate Valve

features: Hexagon shaped body ends; Straight thru ports; Solid one-piece wedge with 6 Micro-Inch finish; Heavy duty forged hand-wheels; Back seating in the bonnet. Available in sizes up to 2".

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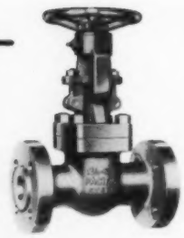
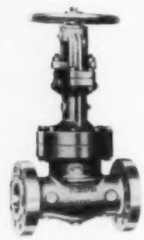
You've seen them every day in every type of service that dictates rugged dependability and performance. From crude lines to high temperature service. From storage terminals to charging lines. On simple, manually operated units to the more complex remote stations... and in a host of sizes and pressure services that is characteristic of their flexible service applications.

And now with stepped-up valve production and expanded foundry facilities, PACIFIC VALVES, INC. makes available to you the one source for meeting all your valve specifications. It could mean a saving to you in time... effort and cost. PACIFIC welcomes the opportunity to avail its technical skills and facilities to the solution of your valve problem.

SMALL STEEL VALVES



CAST STEEL VALVES



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ALUMINUM VALVES

STAINLESS STEEL VALVES

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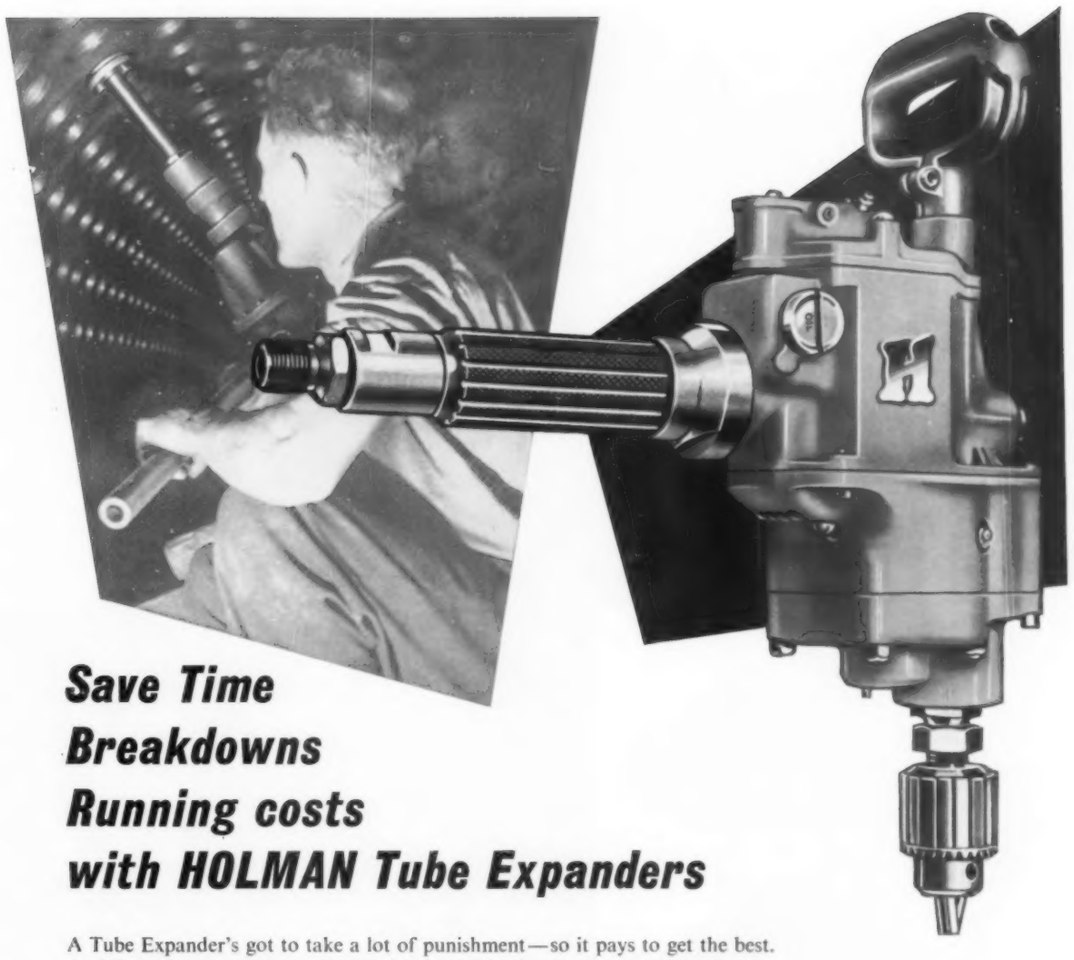

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The motor has been proved in tests and practice to withstand the heavy shock loads of this type of work; for additional reliability the centrifugal-type governor regulates the air supply according to the load and prevents overspeeding. All models are fitted with quick-action and reverse controls; the two-man types are fitted with independent controls for extra safety.

There's no doubt about it—for sheer efficiency and economy in operation, there's nothing like a Holman.

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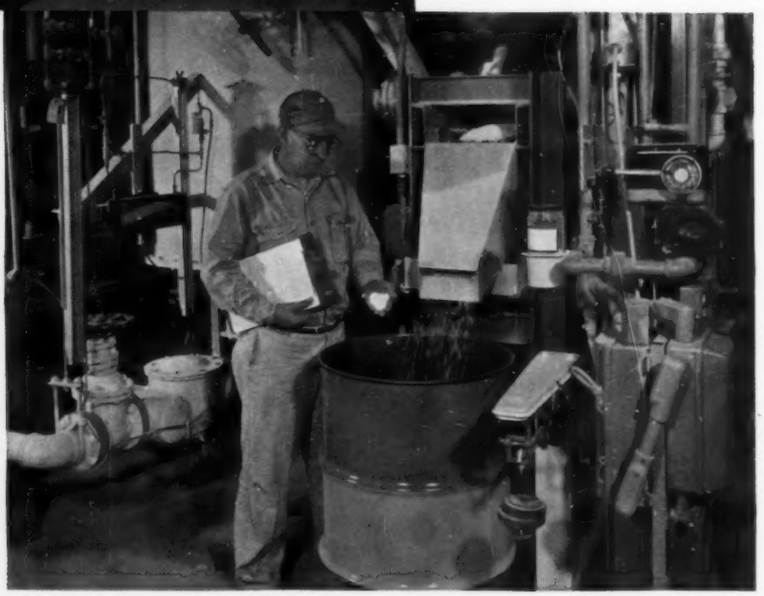
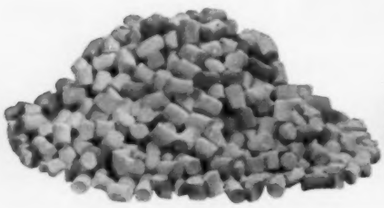
Houdry research constantly works to improve existing catalytic processes and catalysts —and to develop new ones.



At Houdry, rigid quality control is maintained through every step of catalyst manufacture.



Houdry means Progress

...*through Catalysis*

Houdry has had 30 years of continuous activity in the development and design of catalytic processes and catalysts. It has accumulated experience, know-how and facilities unmatched in its field.

Whenever problems arise concerning catalysis, Houdry is in a position to provide the best possible solutions—because Houdry—

- Designs and licenses catalytic installations throughout the world
- Manufactures and supplies a variety of catalysts for established processes, as well as special purpose catalysts tailored to specific individual requirements.
- Provides technical service to assist in selection of catalysts and operation of processes
- Offers contract research to assist in the development of individual processes and products . . . through catalysis

Today, Houdry is accelerating the development of new and improved catalytic processes and catalysts for even more efficient—and profitable—processing than ever before.

In solving the many catalytic problems brought to us, we may already, in essence, have solved yours. Consult with us.

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PROCESS CORPORATION
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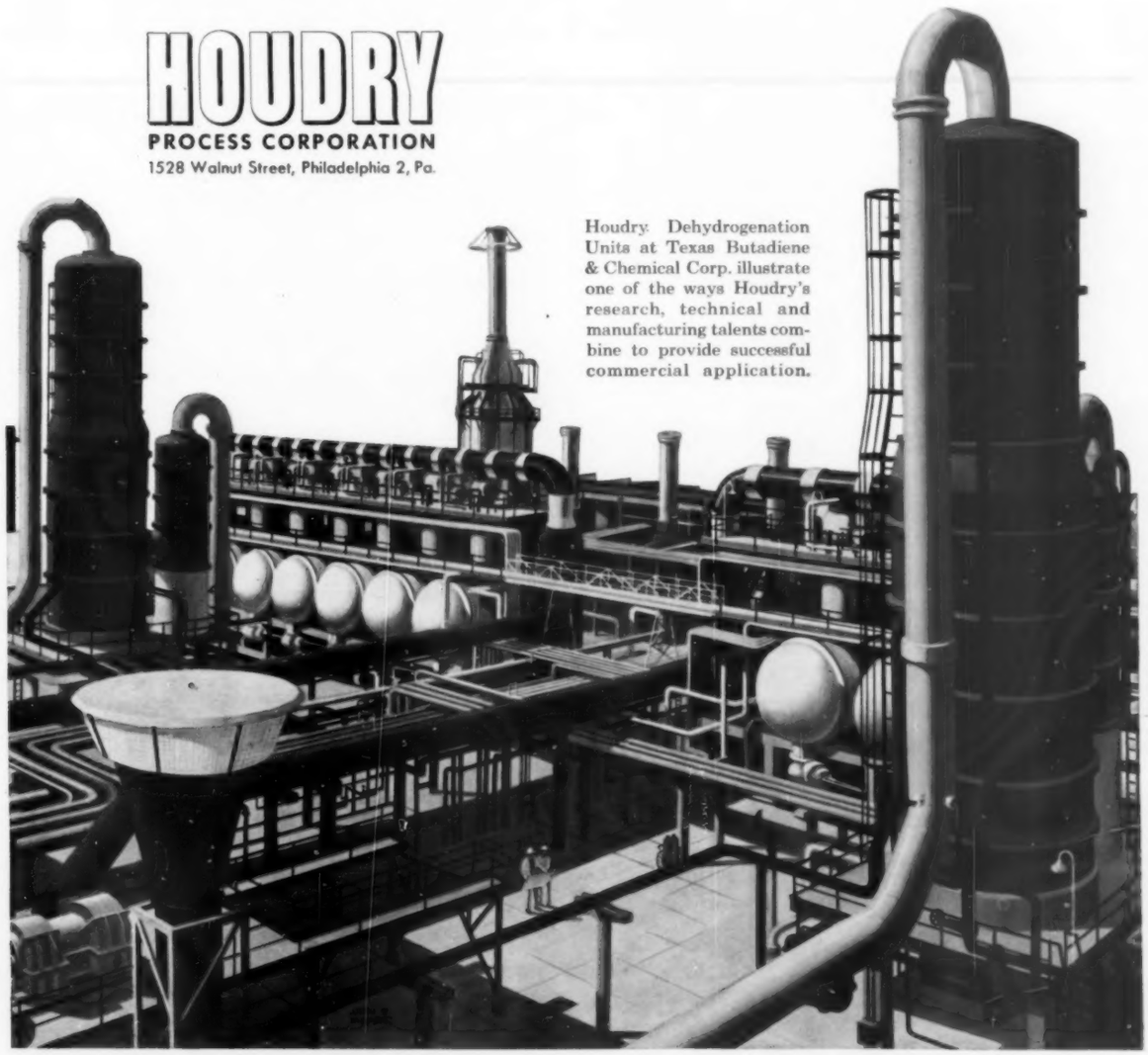

Houdry Dehydrogenation Units at Texas Butadiene & Chemical Corp. illustrate one of the ways Houdry's research, technical and manufacturing talents combine to provide successful commercial application.

an Achievement...

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have been fabricated by

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for 16 major oil companies

These tanks range in capacity from 1800 to 300,000 BBLS

more and more, in all parts of the world, the TUBESEAL* system is recognized as the best whenever and wherever a floating roof is applicable

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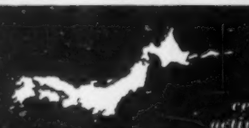

Since 1914 Toyo Kanetsu Kogyo K. K. and its predecessor companies have been actively engaged in the design, fabrication and erection of steel structures and heavy equipment, including steam boilers, storage tanks, bridge structures, chemical machinery and industrial furnaces.

In February 1953, on the basis of T. K. K.'s excellent reputation, Hammond Iron Works granted exclusive rights in Japan for the construction and sale of storage and conservation tanks embodying Hammond designs.

The outstanding success of Toyo Kanetsu Kogyo K. K. is exemplified by the company's recent celebration of the sale of its 100th Hammond Tubeseal Floating Roof . . . a truly remarkable achievement.

Hammond Iron Works is justifiably proud of its association with Toyo Kanetsu Kogyo K. K.

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C. E. Williams, Gulf Sales Engineer, Midland, Texas, and G. W. Ramsey, Assistant Plant Superintendent, inspect force feed lubricators on one of the modern gas engines at the Goldsmith plant of El Paso Natural Gas Company.

No lubrication problems in 8 years of operation

Since 1949, twenty-seven gas engine-compressor units developing 39,985 horsepower at the Goldsmith plant of El Paso Natural Gas Company have been thriving on Gulf Security Oil. Bearing, ring and cylinder wear maintenance records have been excellent.

Insure safe, more effective lubrication protection for *your* compressor units. Specify Gulf Security . . . the high quality, straight mineral oil. For full information, call your nearest Gulf office.

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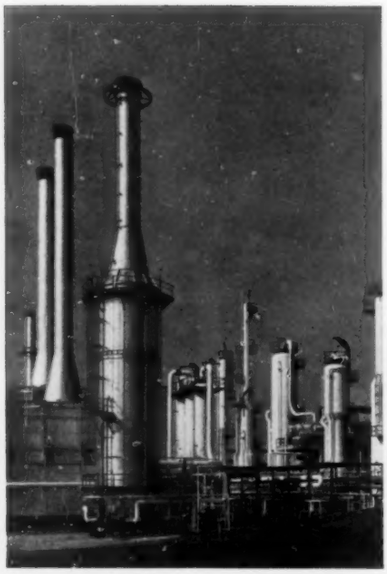


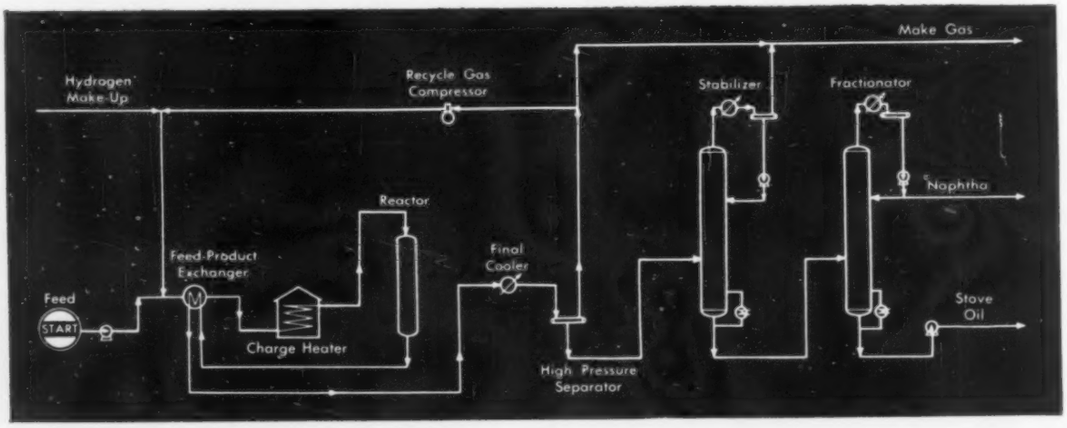
Unifining Unit, Union Oil Company of California refinery, Oleum, California uses Harshaw Cobalt Molybdate Catalyst.

For Hydrodesulfurization

HARSHAW COBALT MOLYBDATE CATALYST

★ **223 regeneration cycles without loss in activity**—a typical performance given by Harshaw Cobalt Molybdate Catalyst, accomplished while treating one of the most difficult charge stocks.

★ **Recording less than 1.0¢/bbl. accumulated costs**—with no indicated loss of activity, Harshaw CO-MO has been full scale tested the longest of any hydrodesulfurization catalyst.



Since you know the critical ingredient of any catalytic hydrogenation reaction is the *catalyst*, the above facts should prompt you to acquire complete details on this premium commodity in the field of catalytic hydrogenation. We shall be happy to point out the many specific advantages that come with using Harshaw Cobalt Molybdate Catalyst and discuss any specific application you may be considering.

Feel free to contact your nearest Harshaw office

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FASTER RIG-UP . . . Unproductive rig-up time is reduced as much as 75% because there are fewer large, heavy units and no mechanical equipment to install or align.

EXTRA MOBILITY . . . Westinghouse equipment is compact and lightweight, suitable for skid-mounting. Each component is designed for easier, faster handling.

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Westinghouse manufactures a complete line of electrical equipment for every phase of the petroleum industry.

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made with CIMENT FONDU Regd Trade Mark ALUMINOUS CEMENT

can be "gunned" or cast-in-place, and depending on the aggregates used can have any fired density between 30-120 lbs. per cu. ft.

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SECAR 250 *Regd Trade Mark*

a super-purity white calcium-aluminate cement with
IRON COMPOUNDS AND SILICA LESS THAN 1%
suitable for IRON-FREE REACTOR LININGS,
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Secar 250 refractory castables have all the advantages of Fondu castables *PLUS* high purity and high refractoriness.

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BLUEPRINT for Economic Achievement

When refining capacity must be increased, an oil company's planning group has to evaluate the technical and economic pros and cons of modernizing by degree or scrapping outmoded facilities and rebuilding completely. When the decision is to start from scratch, hundreds of variables are involved in choosing location, type and range of crudes, product mix, process line up, degree of integration, and refinery size. Which combination will insure the optimum in efficiency, economy, yields, flexibility for the future, and return on investment?

Faced with exactly this time-consuming multiplicity of problems, The Standard Oil Company of Ohio first scheduled decision deadlines for each planning phase, then called upon Kellogg for refinery material balances, estimated process investment costs, operating information, and data on various crudes. Decisions from this study, each made on schedule, served as the blueprint for Kellogg's second assignment—engineering and constructing an integrated new plant at Toledo, Ohio. Designed for a capacity of 60,000 BPSD, this $40 million refinery is an outstanding example of sound economics at work in plant planning and execution.

With most oil companies concerned with tomorrow, there is no better time to be discussing future plans and problems with Kellogg than today. Kellogg's Contract Sales Division welcomes the opportunity to put its coordinated engineering, procurement, and construction services at your disposal.

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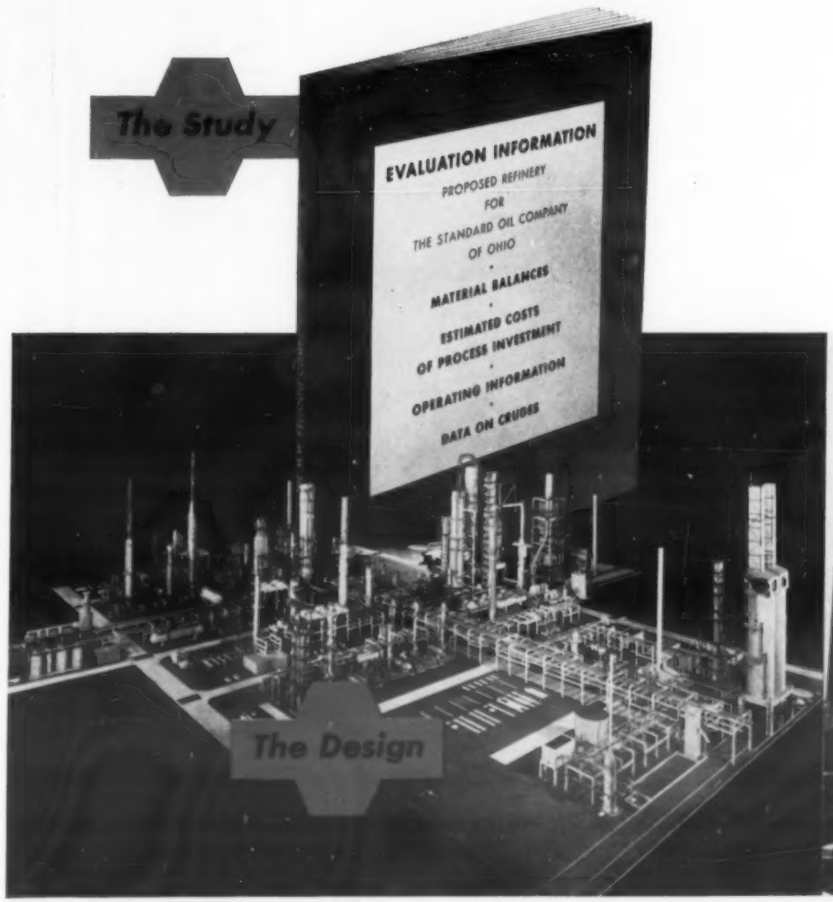
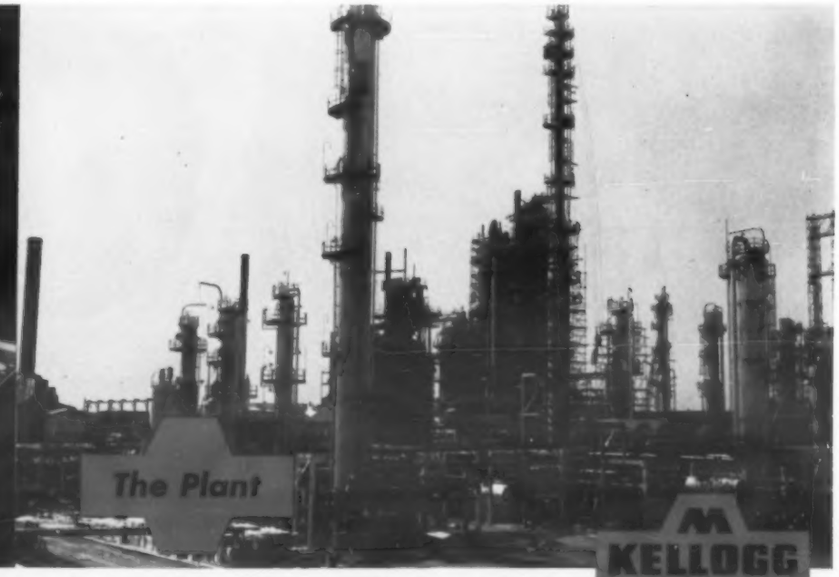
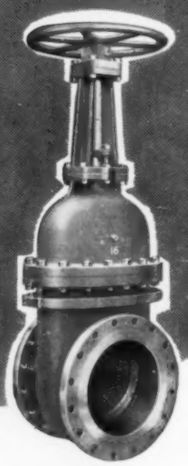


To achieve the ultimate in design, yet assure the most economic plant, Kellogg built this 26' x 29' scale model concurrently with designs to assist all levels of management, as well as all categories of engineering and refinery personnel, in design reviews well in advance of major construction.



Construction almost completed, the major sections of the integrated refinery shape up as: (left to right) the saturate gas plant, the crude section, catalytic cracker, unsaturate gas plant, catalytic polymerization section, and the delayed coker.

Valves & fittings for the oil & allied industries



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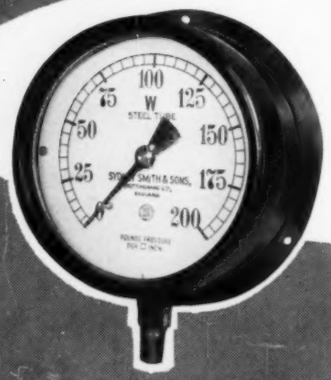

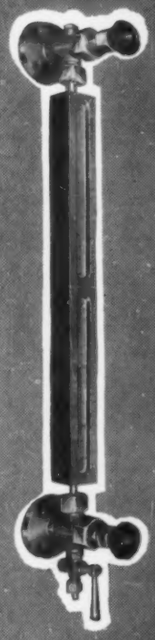

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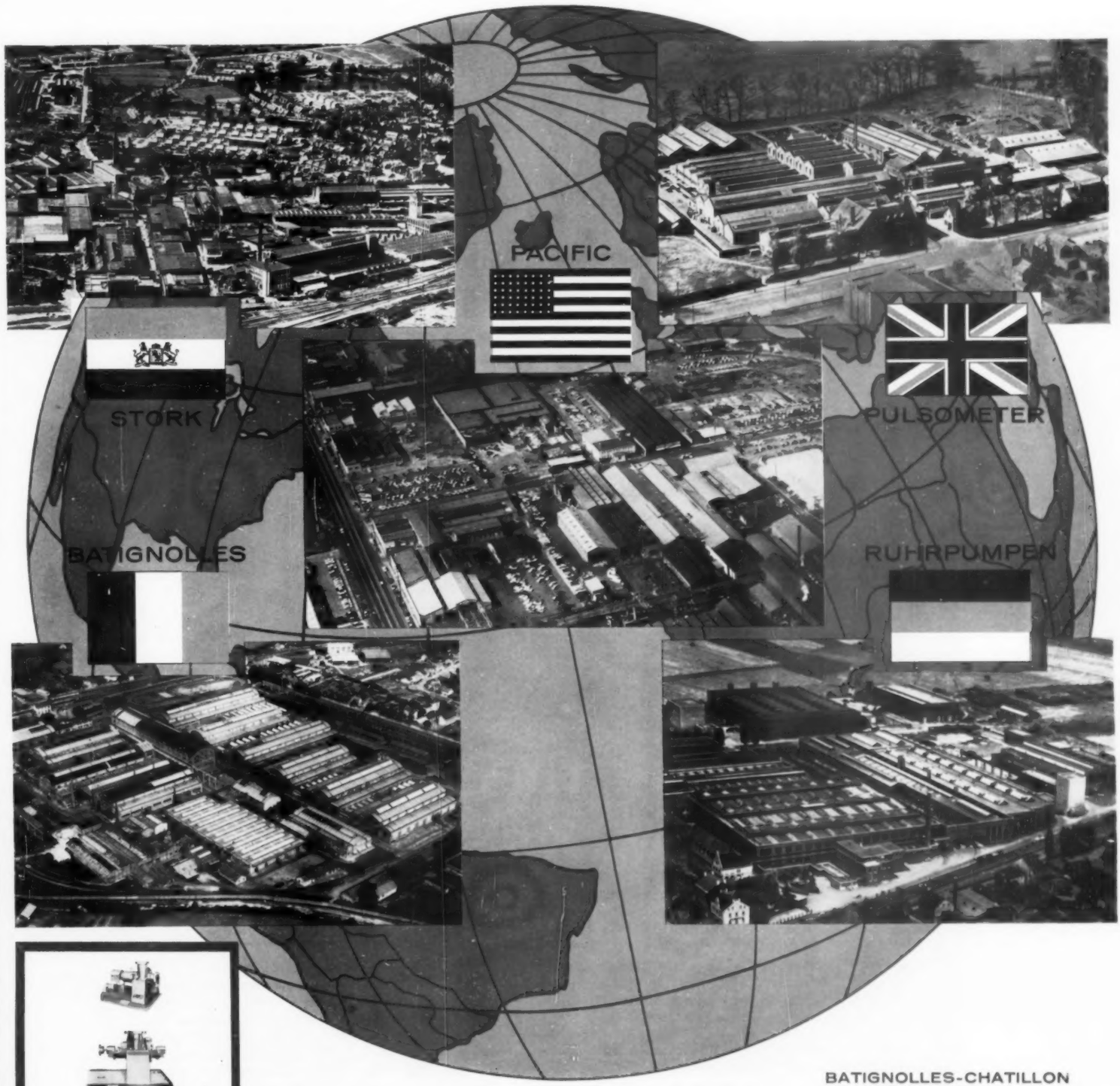

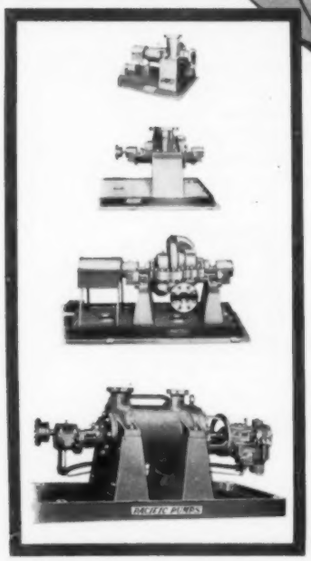

Pacific pumps designed specifically for use in petroleum refineries, petrochemical and other processing plants throughout the world are universally recognized for superior performance . . . long service life . . . trouble-free operation . . . low maintenance costs. Whether these pumps are built in Pacific's American plant or by one of the carefully selected foreign manufacturers—identical integrity of design, engineering, workmanship, materials and service is assured. Through these world-wide facilities, centrifugal pumps of Pacific design may be purchased in Sterling, Francs, Guilders, Marks, Dollars or other foreign currencies. We encourage your inquiries.

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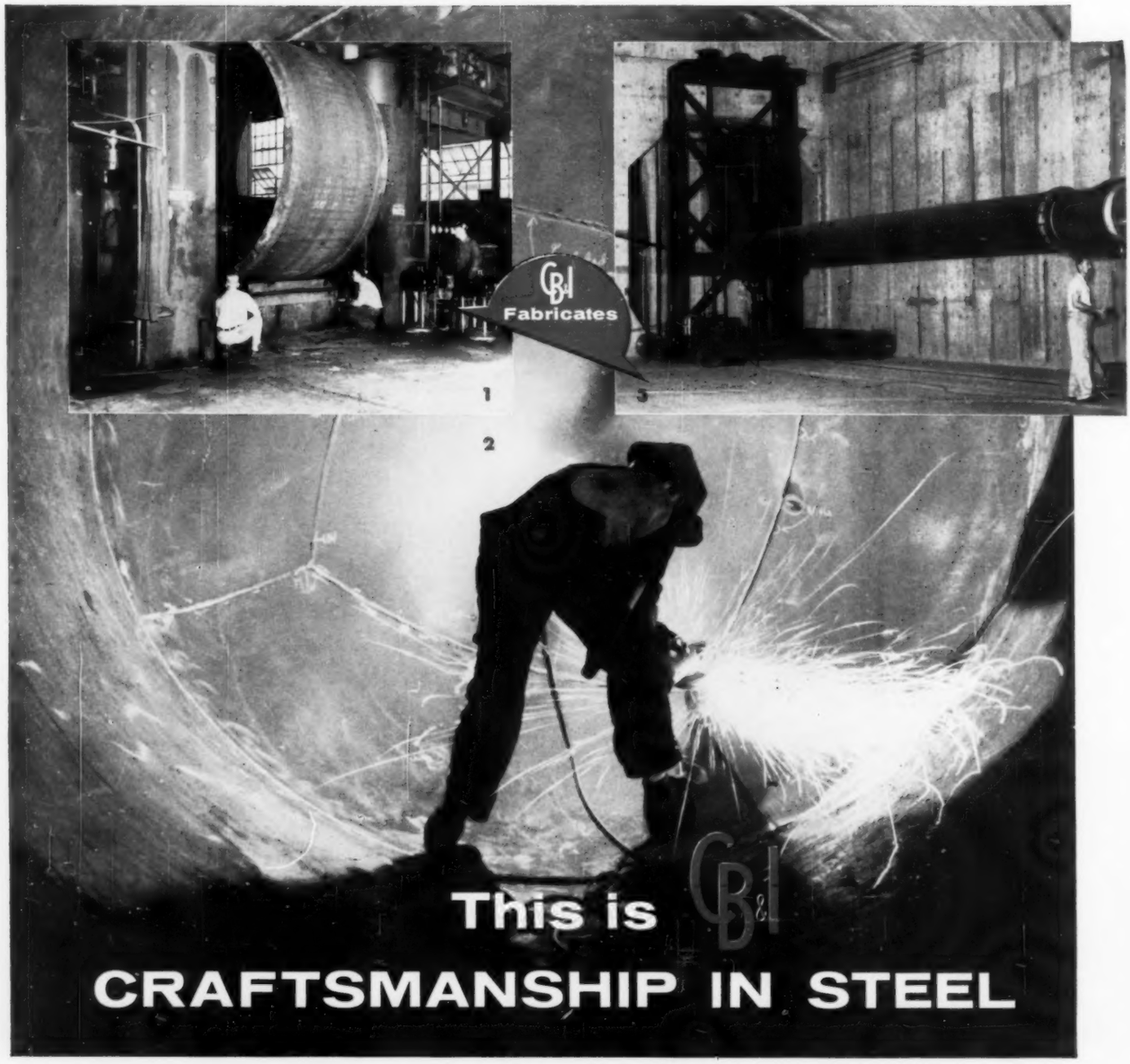

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Almost 70 years of specialization in the design, engineering, fabrication and erection of steel plate structures will build long and efficient performance life into your next CB&I-built structure. *Here's why:*

CB&I Engineers. From first contact with the customer through final testing, CB&I's general engineering staff supplies technical guidance to the CB&I team. Important coordination between fabricating, erection and testing is thus insured.

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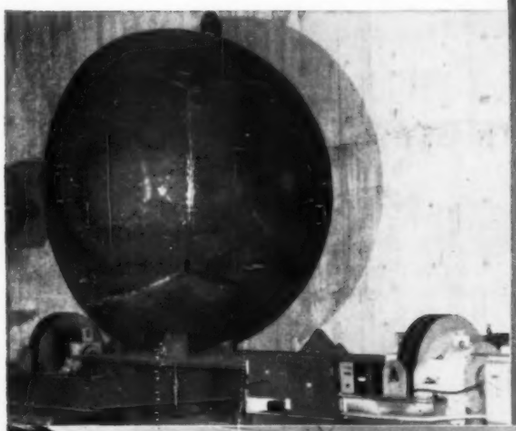
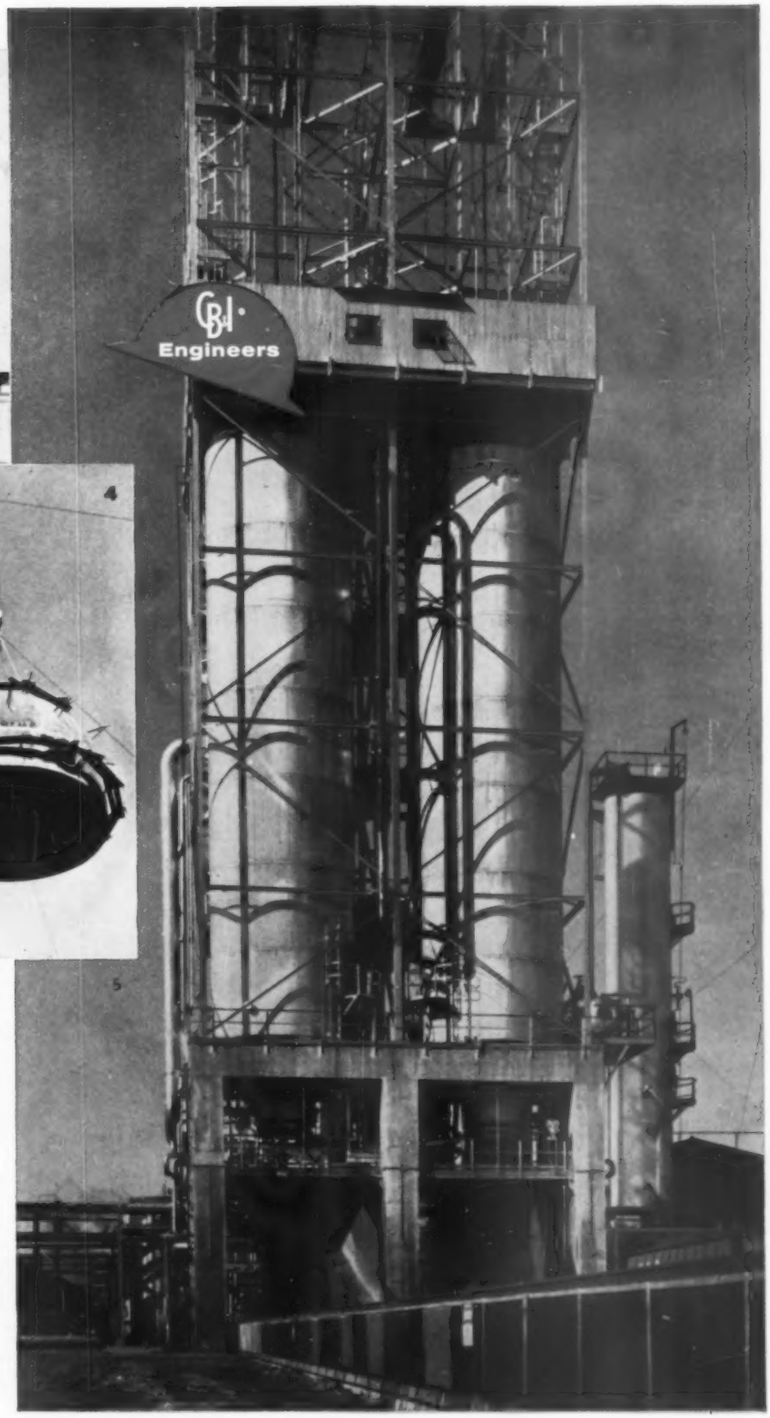
CB&I Erects. Skilled, responsible crews work with up-to-date equipment. Field X-ray and stress relieving equipment, in addition to CB&I-developed welding techniques, are an important part of their trade. Experience in a wide variety of metals, including stainless, nickel, aluminum and clad materials are also part of the service that has earned CB&I a *global* reputation for erecting on a *world-wide* basis.

These coordinated services are what you receive when you contract for a CB&I-built structure. CB&I customers have learned to expect and get top rated performance and maximum service life from *CB&I craftsmanship in steel.* Write our nearest office for details. Ask for the CB&I Bulletins on: *Special Plate Structures* and *CB&I Field Services.*





1 5-in. thick plate for reactor is fabricated at CB&I's Birmingham plant.

2 Workman smooths seams on an assembled section.

3 X-ray machine checks seam welds. Machines operating at 1,000,000 and 2,000,000 volts are used to completely inspect steel vessels as much as 10 inches thick.

4 72-ton top section for reactor-regenerator is lowered into position under supervision of CB&I erection specialist.

5 405 STAINLESS STEEL HORTONCLAD® coking chambers were fabricated and erected by CB&I for a Kansas refinery. Stainless is backed by A204 Grade A moly steel.

Hortonclad®, developed by CB&I, is a composite metal having an integral and continuous bond produced by a high vacuum bonding process. It is available only in CB&I fabricated tanks, pressure vessels and other clad structures.

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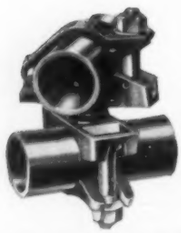

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1968
5,500,000

1958
3,000,000

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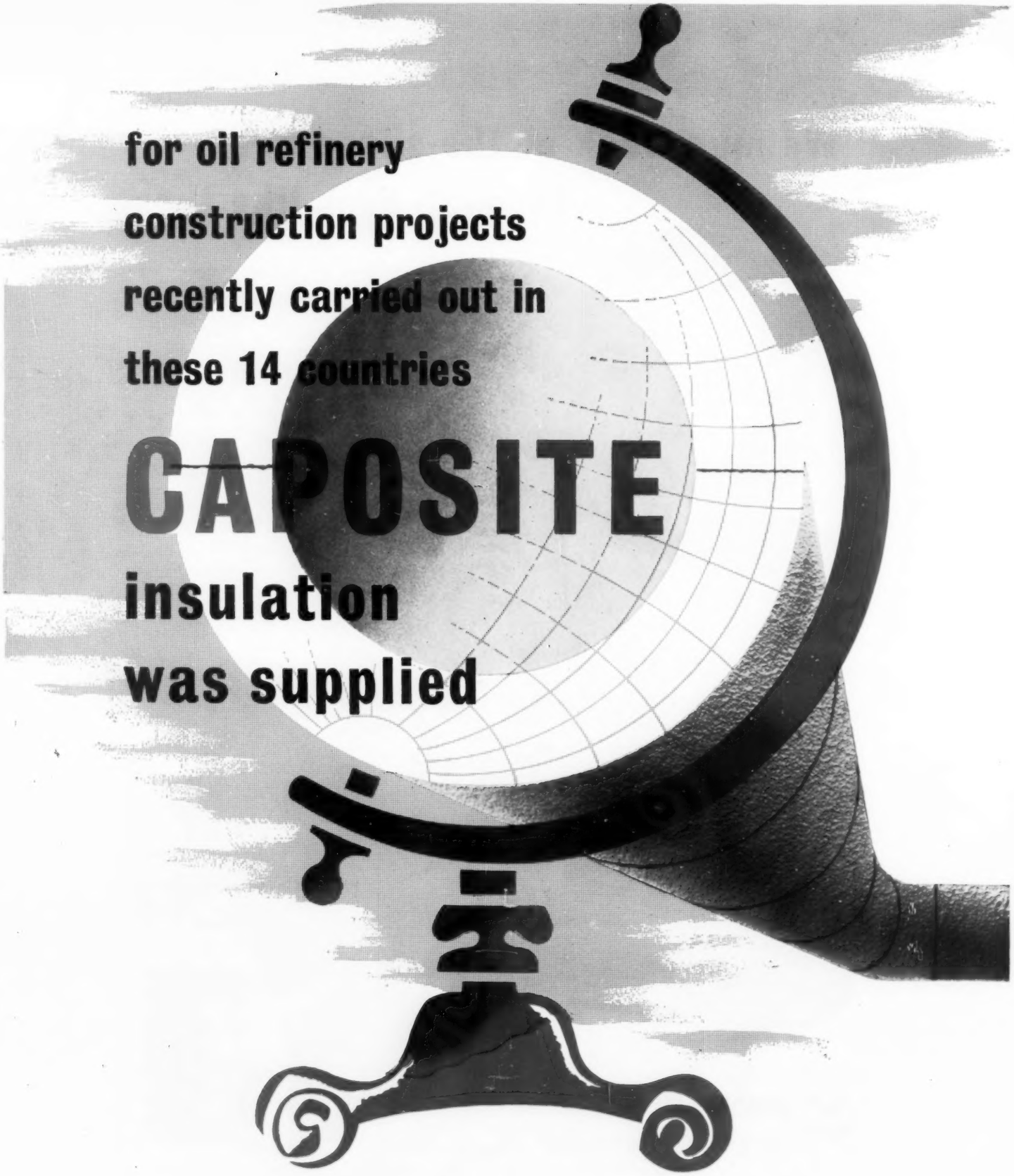
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COLOMBIA *at Cartagena*
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ECUADOR *at La Libertad*
for the Anglo-Ecuadorian Oil Co. Ltd. Main Contractor: Procon (G. B.) Ltd.

ENGLAND *at Kent Oil Refinery*
for The British Petroleum Co. Ltd.

FRANCE *at Raffinerie de Normandie*
for Compagnie Francais de Raffinage. Main Contractors: Kellogg International Corporation and Foster Wheeler Ltd. (France). (Insulation Contractor: Soc. Technibol).

IRAQ *at Daura, near Baghdad*
for Iraq Government Oil Refinery Administration. Main Contractor: Foster Wheeler Ltd. (London).

ITALY *at Genoa*
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KUWAIT *at Akmadi*
for the Kuwait Oil Co. Ltd. Main Contractor: Bechtel-Wimpey and E. B. Badger & Sons Ltd.

THE NETHERLANDS *at Pernis*
for N. V. de Bataafsche Petroleum Maatschappij.

NETHERLANDS ANTILLES *at C.P.I.M. Refinery, Curacao*
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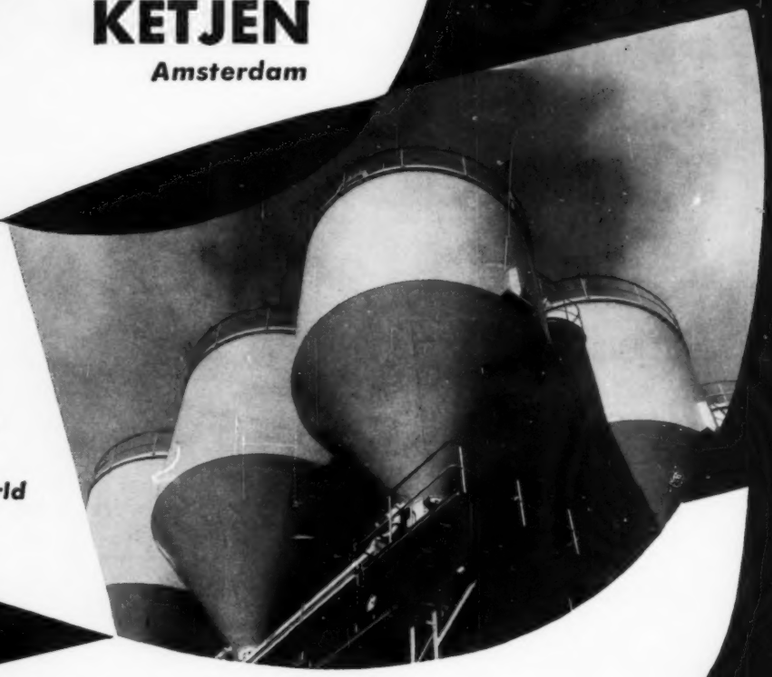

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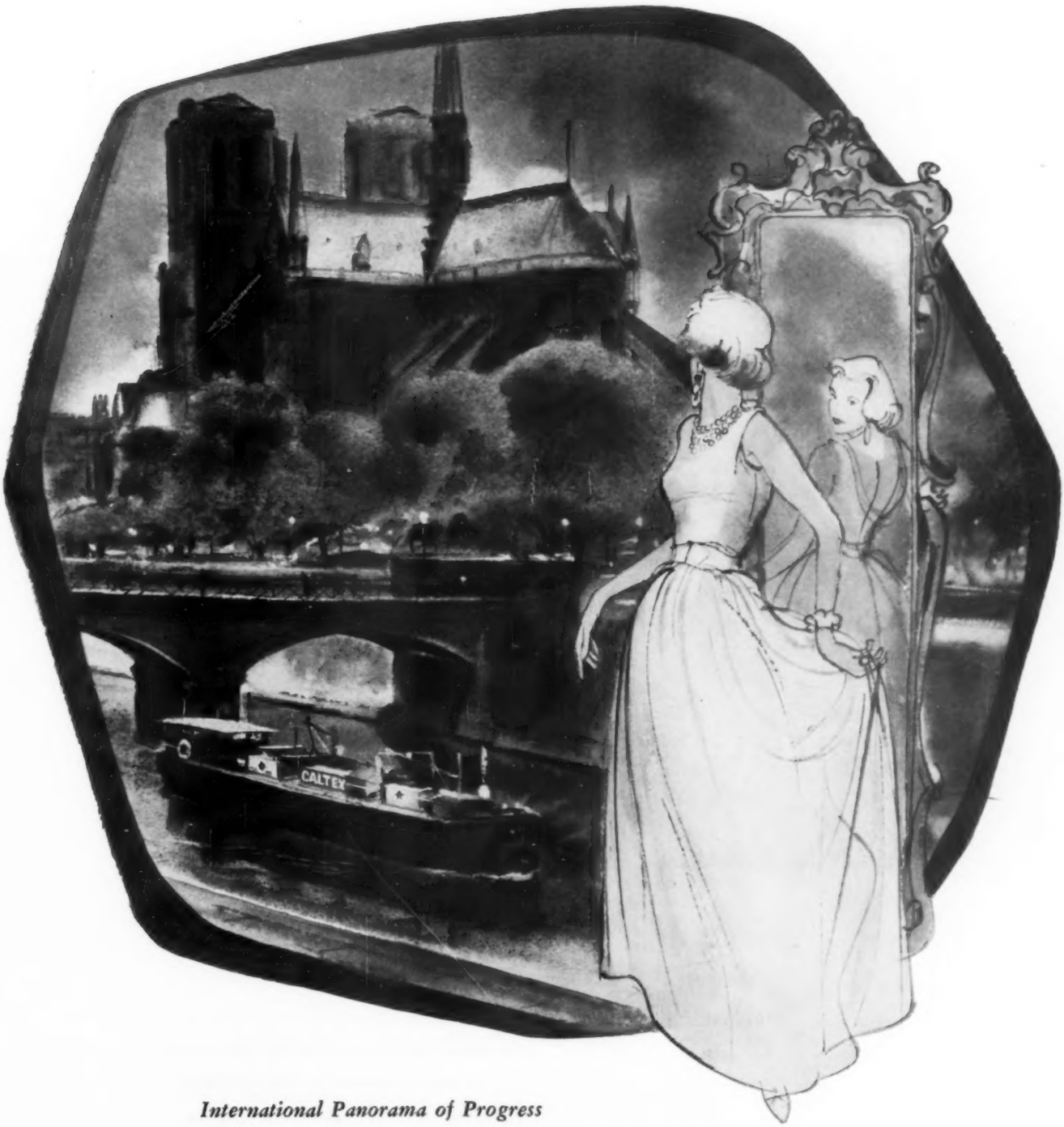

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In many countries, the subtle influences of past traditions and customs have been combined with modern materials and modern design to create completely new trends in fashion ☆ This resurgence-in-textiles on the part of European and other nations has broadened their panorama of progress and created a wider world for fabrics through expanded production, employment and opportunity ☆ The textile industry is just one of many nourished by Caltex quality fuels, oils and lubricants ☆ Through the power of petroleum, Caltex keeps industry and every segment of society expanding, contributing to the prosperity of today and holding forth the promise of an even brighter tomorrow to over 70 countries—partner in progress in Europe, Africa, Asia, Australia and New Zealand.

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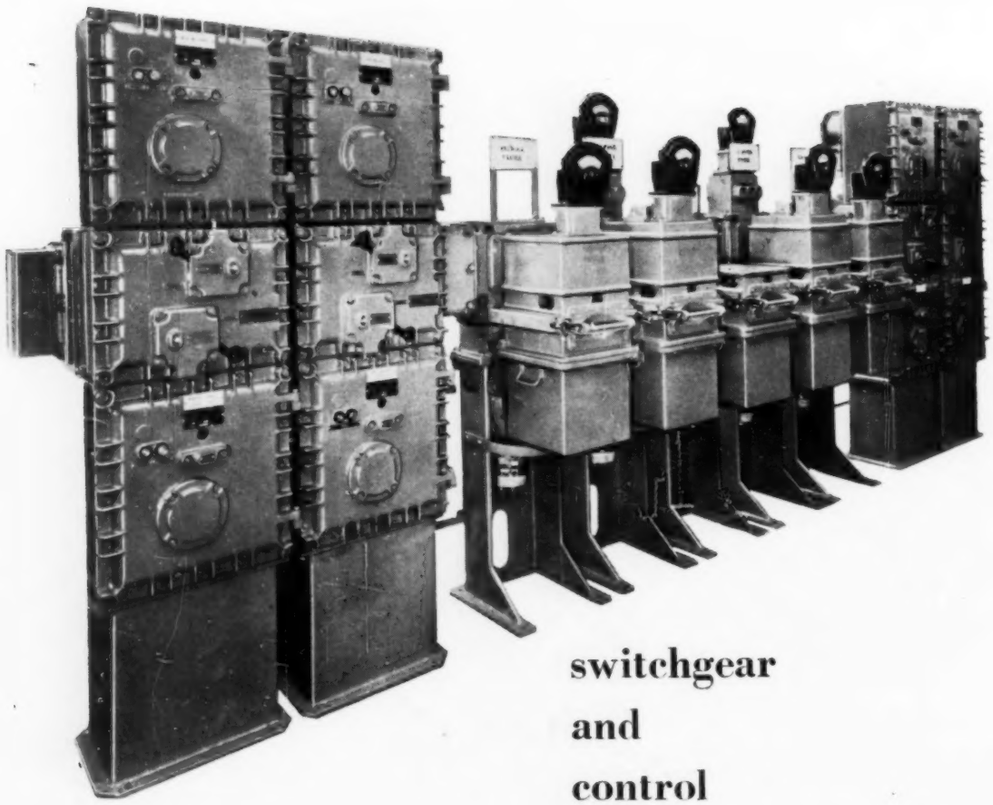

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Throughout Asia, Africa and the lands of the Pacific, new industries call for more oil. And Standard-Vacuum is doing its best to meet the demand. Stanvac finds the oil, transports and refines it, then delivers the finished products—all within the area where Stanvac operates.

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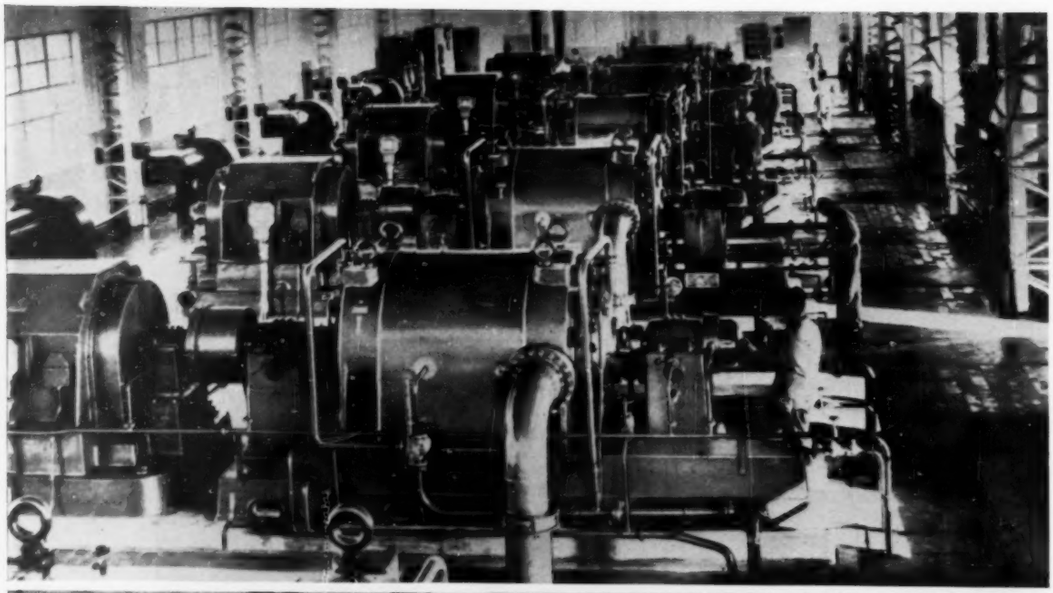
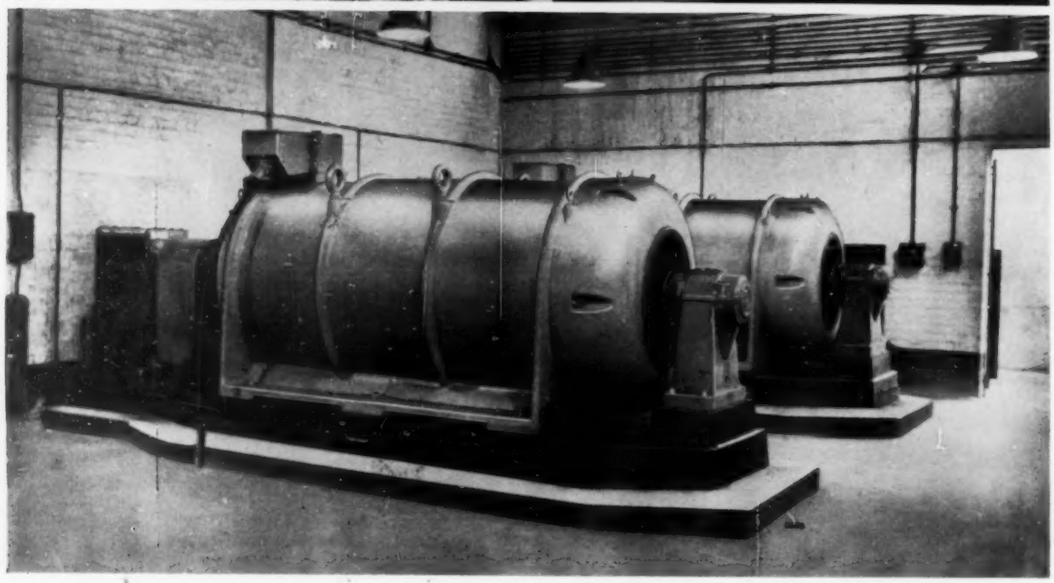


Plurovane pumps in a Middle East crude oil pumping station. Each unit has a duty of 3,800 g.p.m. at 400 lb/sq. in. delivery pressure, and is driven at 980 r.p.m. by a Mather & Platt 1,500 b.h.p. motor.



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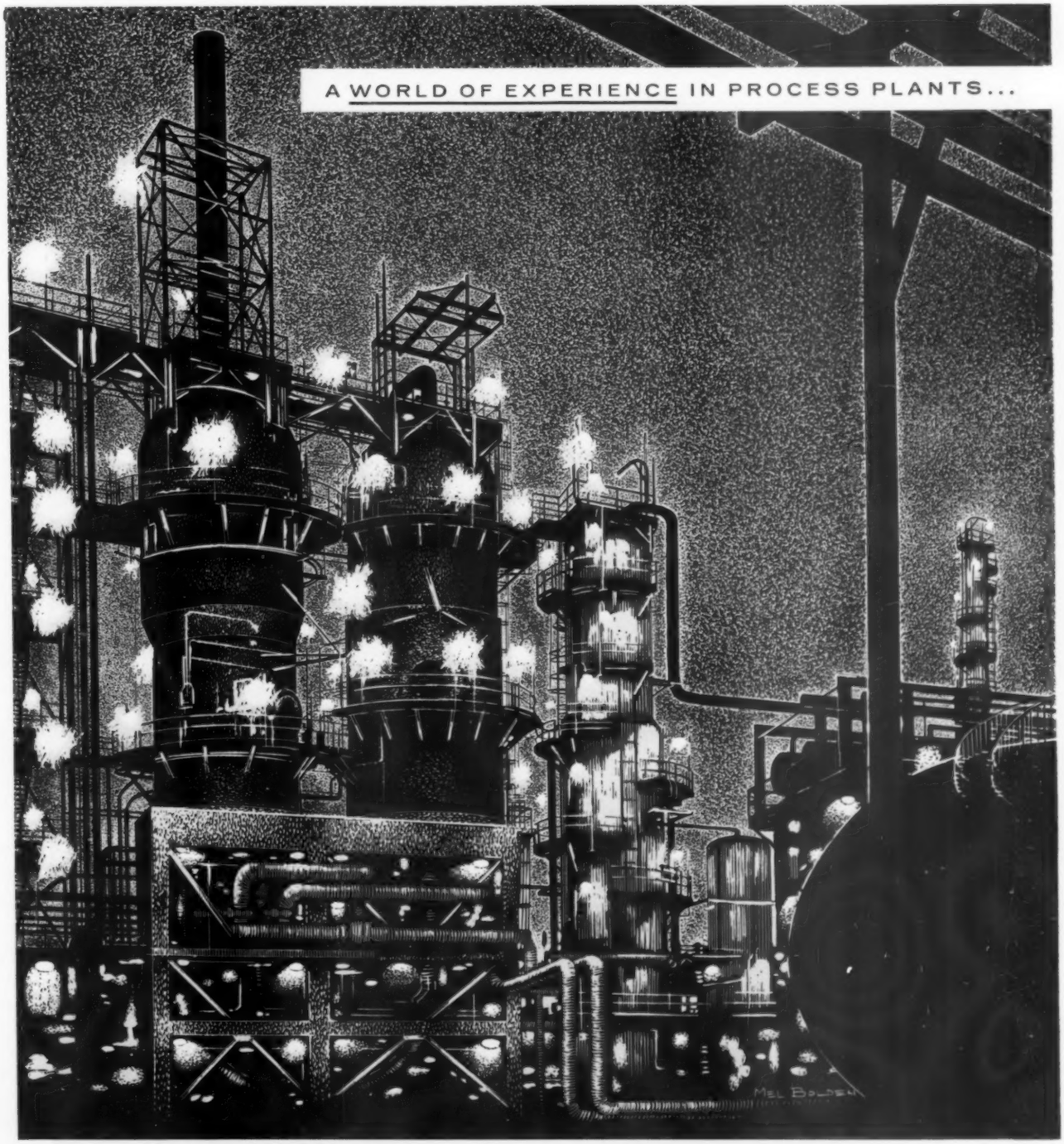

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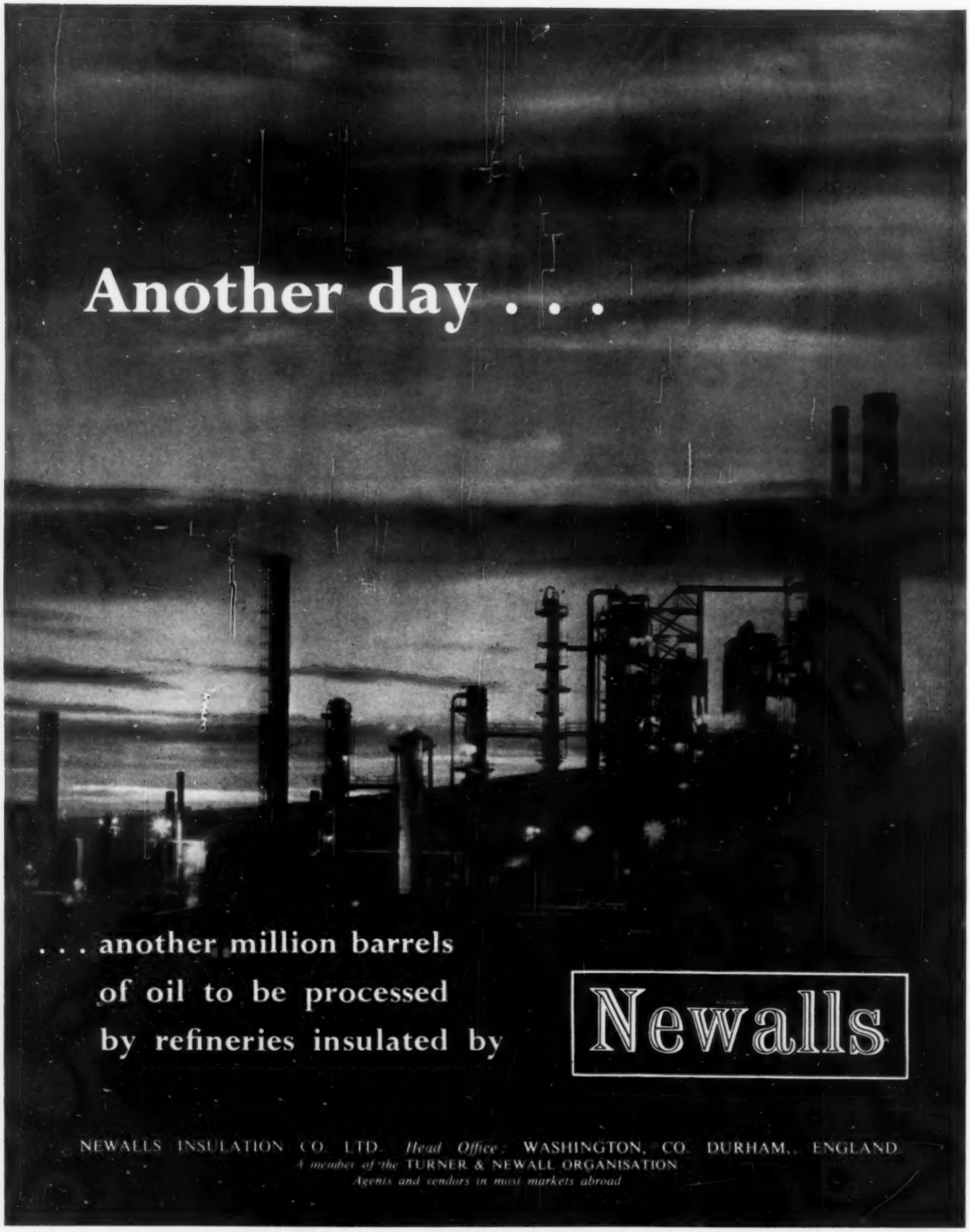
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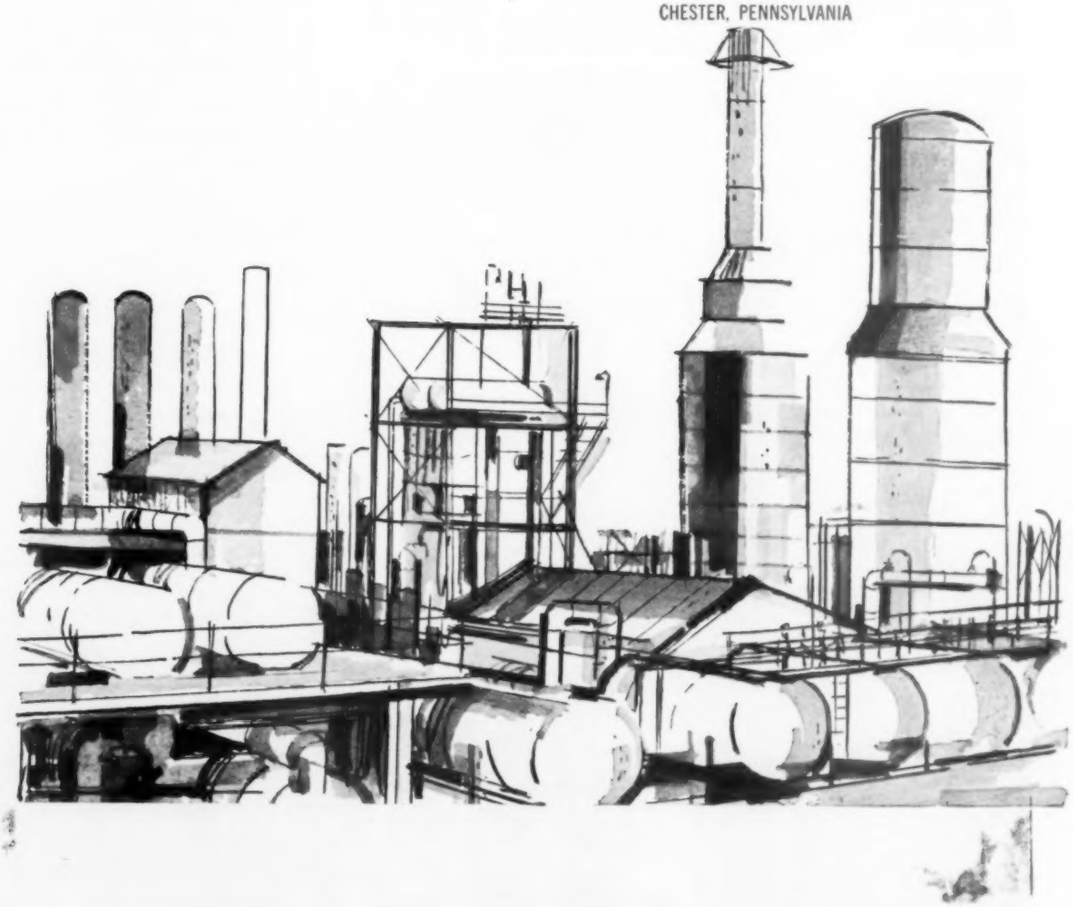

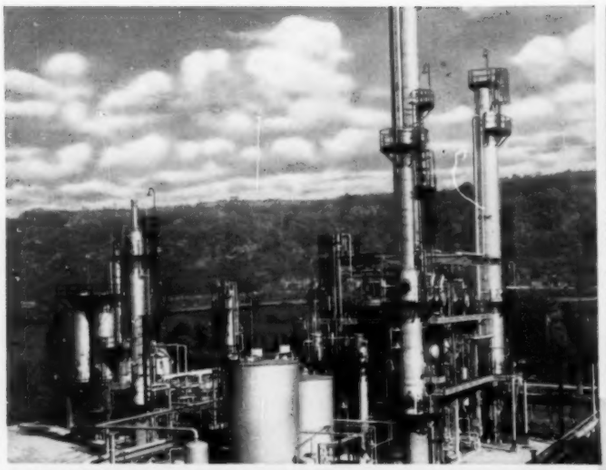

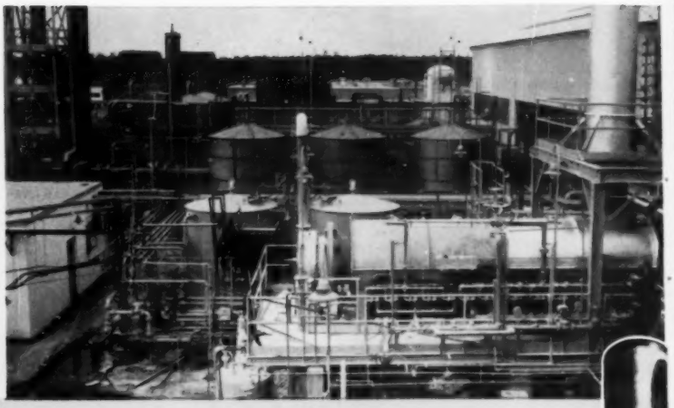

They bring the "tough ones" to Badger

On these two pages are shown a few of the difficult projects successfully completed by Badger during the past year.

They were tough, but we did them. As a result of accomplishments like these, Badger's growth in '57 was double the previous year's.

Now, we think we have earned the right to an easy assignment. *You* have the right to think that if Badger can do the tough ones so well,

Badger can do the easy ones better, too

It's worth investigating — and easy. Key Man Service can be yours in a matter of hours — call or write today!

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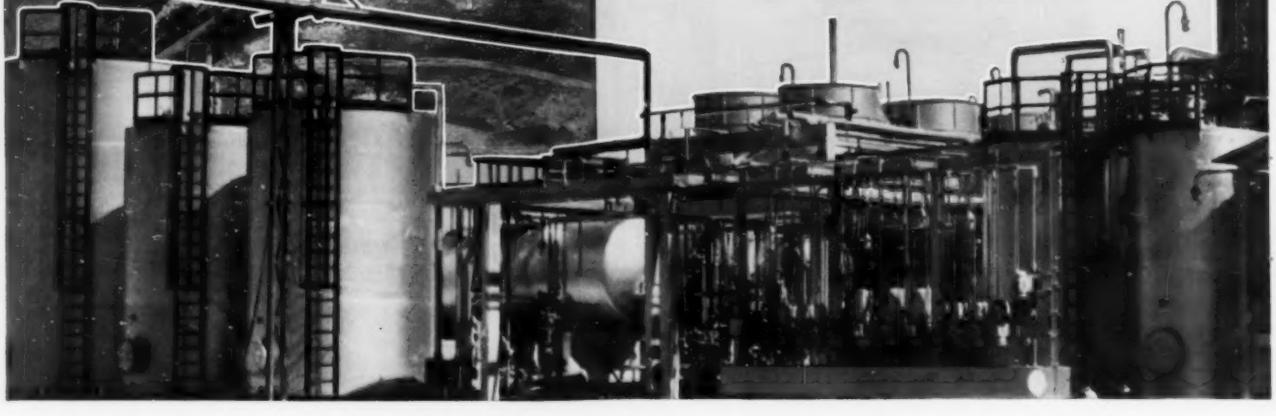

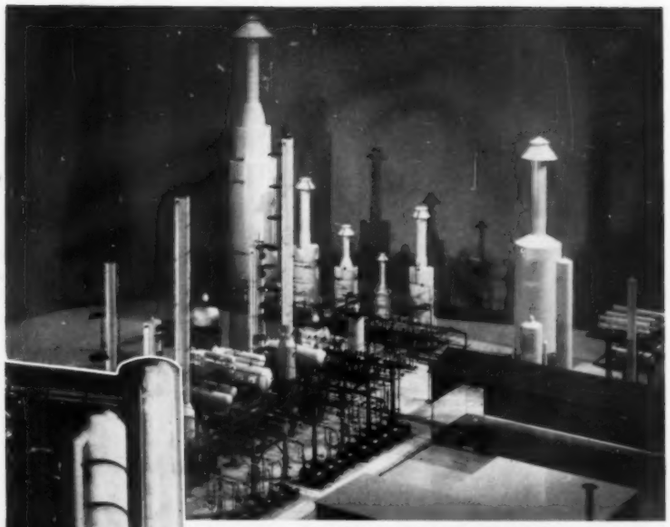

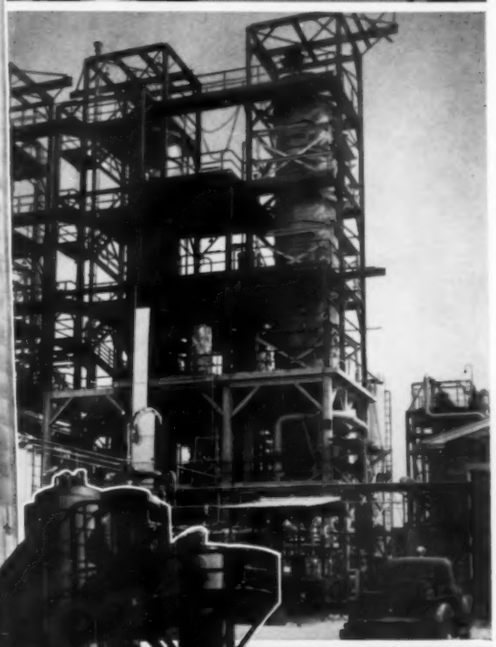

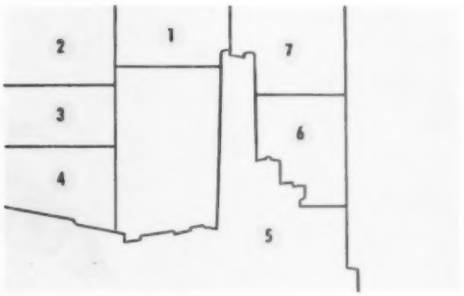

1 **Columbia-National Corp., Pensacola, Fla.** This plant, engineered and constructed for Columbia-National Corporation, will produce 1,500,000 pounds of hafnium-free Zirconium per year.

2 **Jones & Laughlin Steel Corp., Aliquippa, Pa.** Revolution in coal chemicals! For Jones & Laughlin Steel Corporation Badger engineers came up with a new process application that eliminates the conventional acid-washing step to produce near absolute pure benzene and toluene.

3 **Esso Standard Oil Co., Everett, Mass.** One of three current Powerformer projects being handled by Badger. Unit shown is now producing Golden Esso Extra at Esso's Everett, Massachusetts, refinery. Plant was built completely on "stilts" — piles driven deep into tideland marshes.

4 **Metal Hydrides Inc., Danvers, Mass.** A new plant for the production of Sodium Borohydride, a component of "exotic" fuels. Badger handled the engineering, procurement and construction on this job. Plant was ready in record time even though the process was new and tricky.

5 **Cosden Petroleum Corp., Big Spring, Texas.** Styrene from gasoline! Ultra-fractionation and other pioneering process developments made this "impossible" plant a commercial reality. On stream in February 1957, the plant produced better than plastic-grade styrene right from initial start-up!

6 **Commercial Solvents Corp., Sterlington, La.** More methanol facilities. This unit is one of four built in recent years for Commercial Solvents Corporation. Like all methanol units designed by Badger, no chemical purification step is used, yet the product exceeds all present purity specifications.

7 **Esso Nederland N. V., Rotterdam, The Netherlands.** Model of two process units similar to those being installed in a complete 100,000 bpsd refinery, now under construction in Rotterdam for Esso Nederland N. V. Badger-Comprimo, owned jointly by Badger and Comprimo N. V., The Netherlands, is prime mechanical, engineering and construction contractor.

Other current Badger projects

Propane Deasphalting Unit — Anderson-Prichard Oil Corp., Arkansas City, Kansas • MEK Dewaxing-Deoiling Plant — Atlantic Refining Company, Point Breeze, Pa. • HF Alkylation Unit — Champlin Oil & Refining Company, Enid, Okla. • Sulfuric Acid Alkylation Unit — Chinese Petroleum Corporation, Taiwan, Formosa • Continuous Tar Distillation Plant* — Dominion Tar & Chemical Co., Ltd., Hamilton, Ontario • Powerforming Unit** — Esso Standard Refinery S. A., Antwerp, Belgium • Tall Oil Plant —The Glidden Company, Port St. Joe, Fla. • Benzene Udex Unit — Humble Oil & Refining Company, Baytown, Texas • Tall Oil Plant — Monsanto Chemical Company, Nitro, W. Va. • Methanol Plant — Rohm & Haas Company, Houston, Texas • MEK Dewaxing-Deoiling Plant — Sinclair Refining Company, East Chicago, Ind. • Vacuum Distillation Unit — Sinclair Refining Company, East Chicago, Ind. • Paraxylene Plant — Sinclair Refining Company, Houston, Texas • Xylene Udex Unit — Sinclair Refining Company, Houston, Texas.

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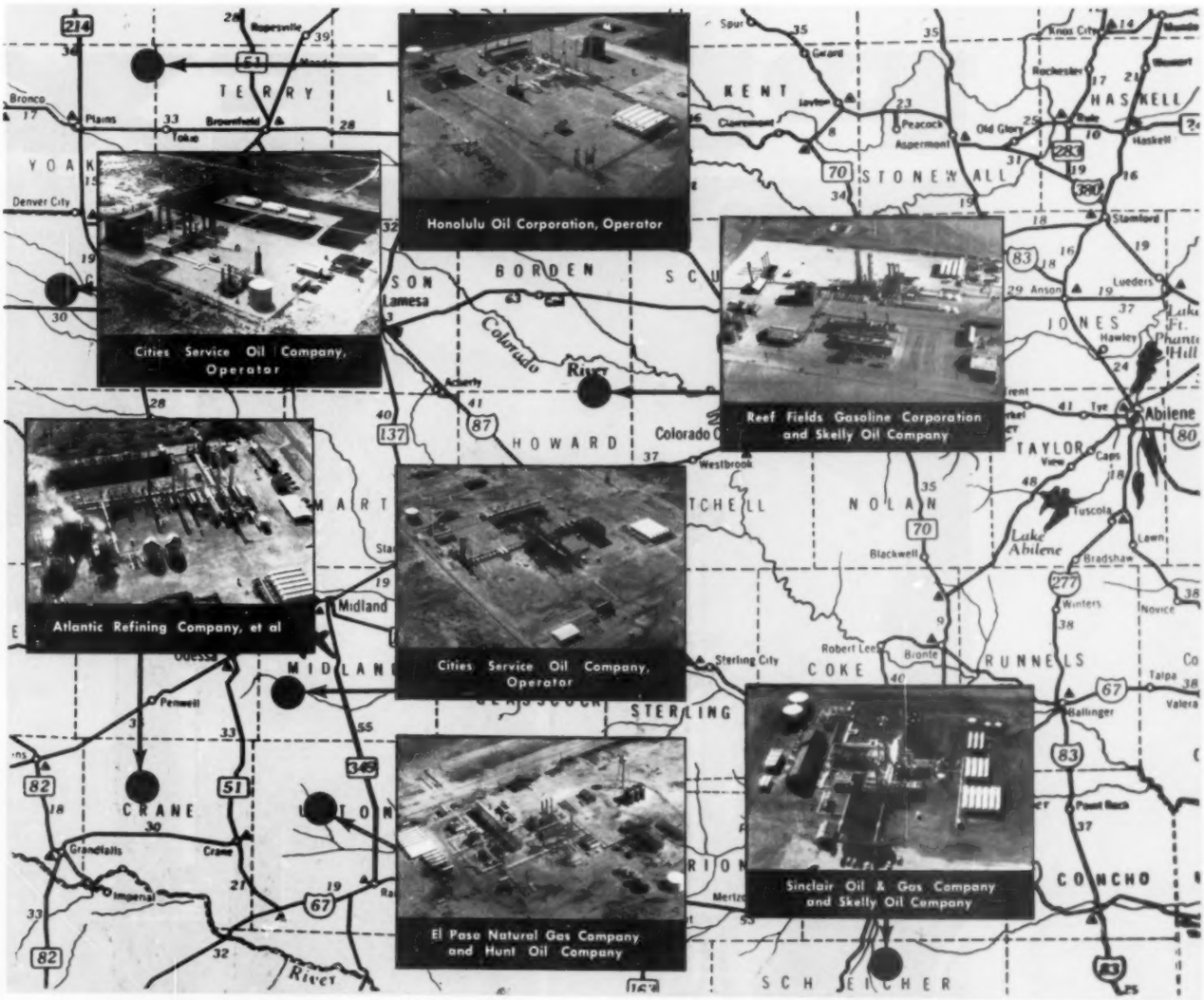

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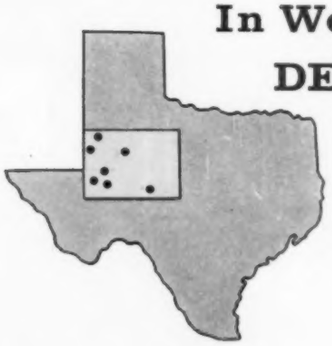

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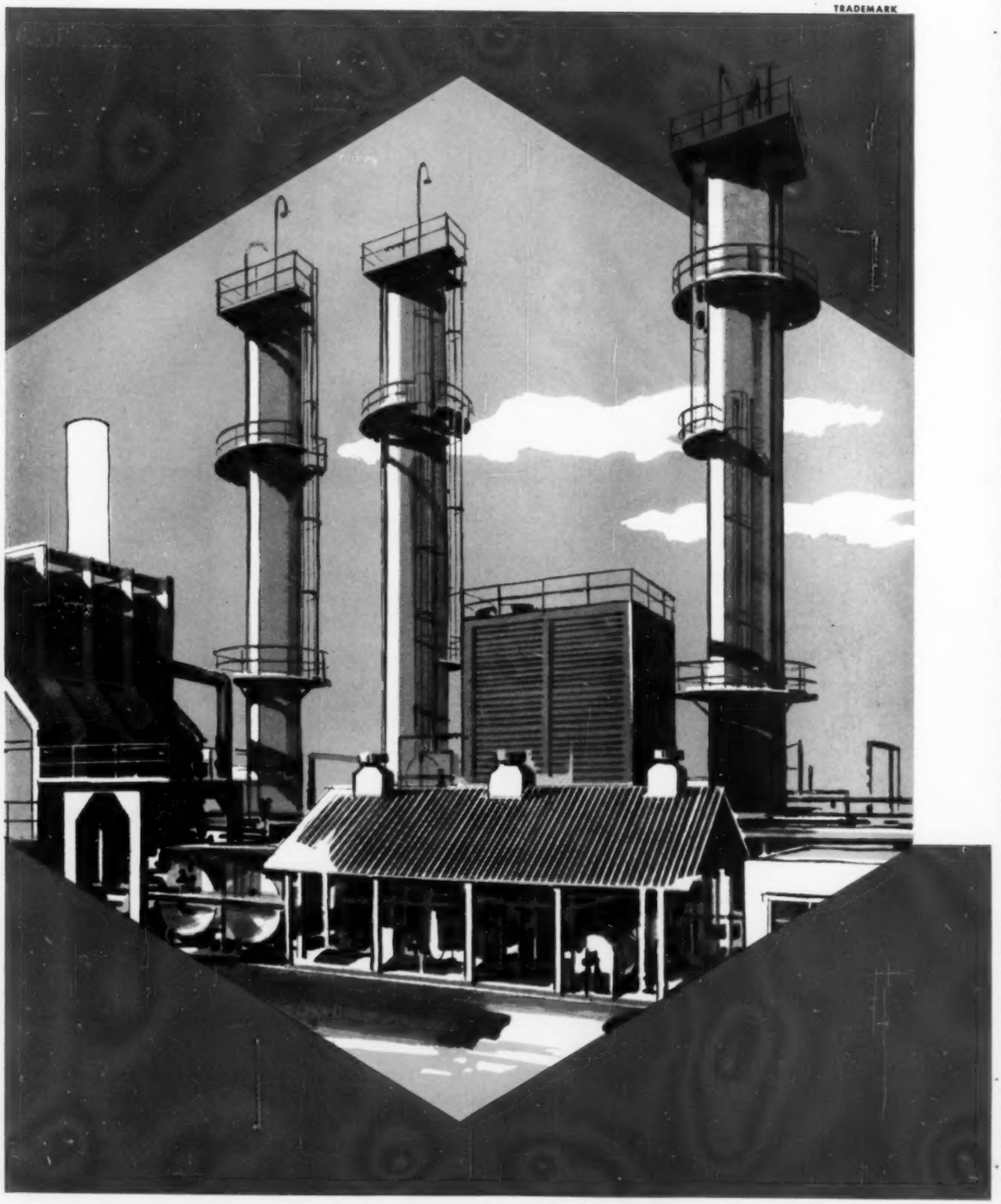

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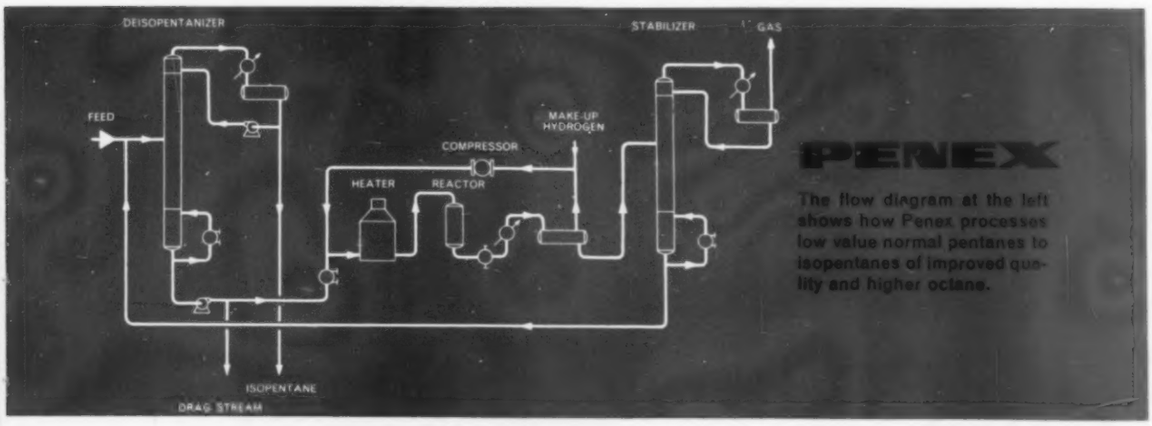

PENEX

The flow diagram at the left shows how Penex processes low value normal pentanes to isopentanes of improved quality and higher octane.

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Photograph by courtesy of the builders, Vickers-Armstrongs (Shipbuilders) Ltd.

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This integrated plant was built from the ground up in 18 months

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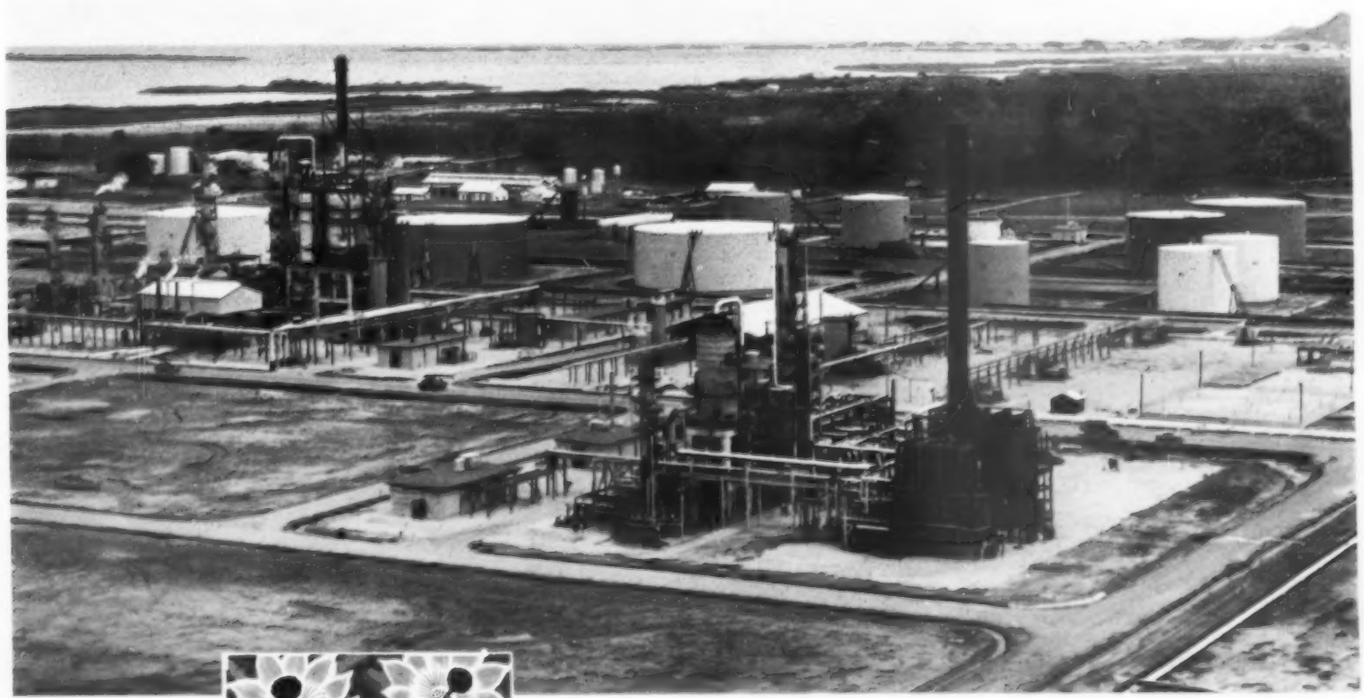

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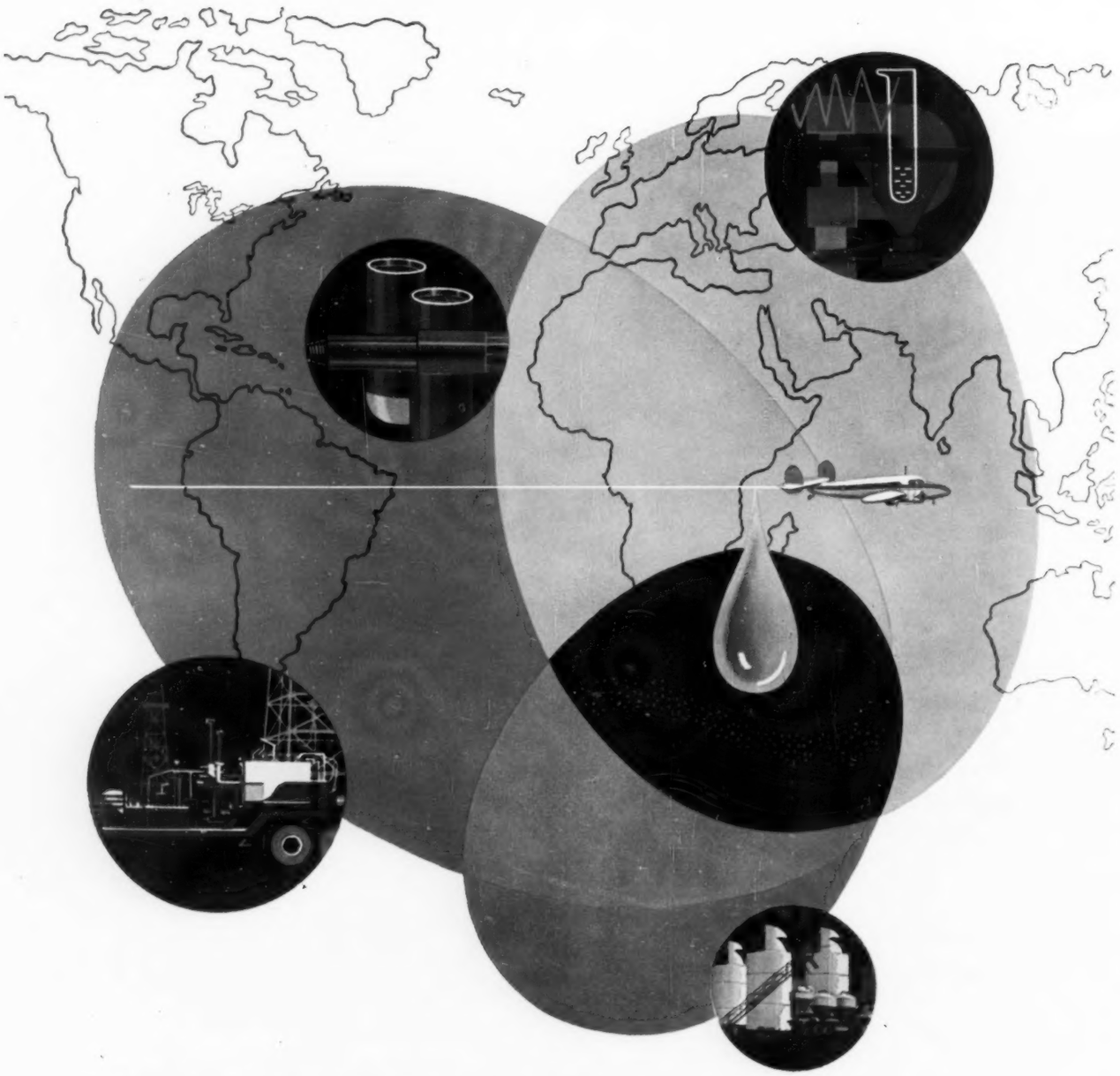

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Here We Go Again

The indictment of 29 oil companies by a federal grand jury in Virginia comes as a shock to the industry. The true bill is particularly disconcerting because it reveals how little the average citizen understands the way in which business is—and must be—done in a free economy marked by intense competition between a large number of companies and individuals.

Another aspect of the situation which must cause the oil-company executive to become aghast is that the indictment arises from an effort on the part of the industry to aid in a national emergency. This is not the first time the industry has been rewarded with an expensive law suit as a result of its efforts to help out at the request of the government. The Madison case is still green in the memory of many. Because the industry cooperated in seeking to stabilize the industry in a period of deep depression—doing so under government supervision—it was forced to spend millions of dollars and waste uncounted hours to defend itself in court.

One thing can be said of the Madison case. It did teach the industry that price must never be discussed at any meeting, even though sponsored by a government official. It made oil men wary of any sort of cooperation without explicit approval from the Department of Justice and the attendance of government representatives at every meeting.

This policy was followed during the Suez emergency, and now it appears that even such scrupulous observance of the ground rules was not sufficient to avoid harassment. As a result, oil managements now must ask themselves under what circumstances they should cooperate in any future emergency. Should they sit on their hands and await a formal Presidential request in case of a stoppage of production in some major area or an interruption in transportation caused by closure of Suez or sabotage of an important pipeline? Why jeopardize the interests of stockholders by an offer to cooperate? Would it be wiser to put the burden of initiating group action on the government?

It is said that the Department of Justice was somewhat surprised when the grand jury returned an indictment—that the government attorneys who presented their case felt they had failed to show any collusive price fixing. If this be true, it becomes apparent that the department must have been doing "busy work" or it would not have conducted such a long inquiry without having been convinced by previous investigation that the law had been violated. What can be said for the department if it had no real evidence to present to the jurors? Was it merely a "witch hunt"?

It becomes clear that the average citizen who makes up a grand jury does not know how markets are made in the oil industry. Had he known the mechanism by which prices are made, he would not have been willing to vote an indictment without genuine proof that Mr. X talked with Mr. Y and between them agreed that a certain price should be higher or lower.

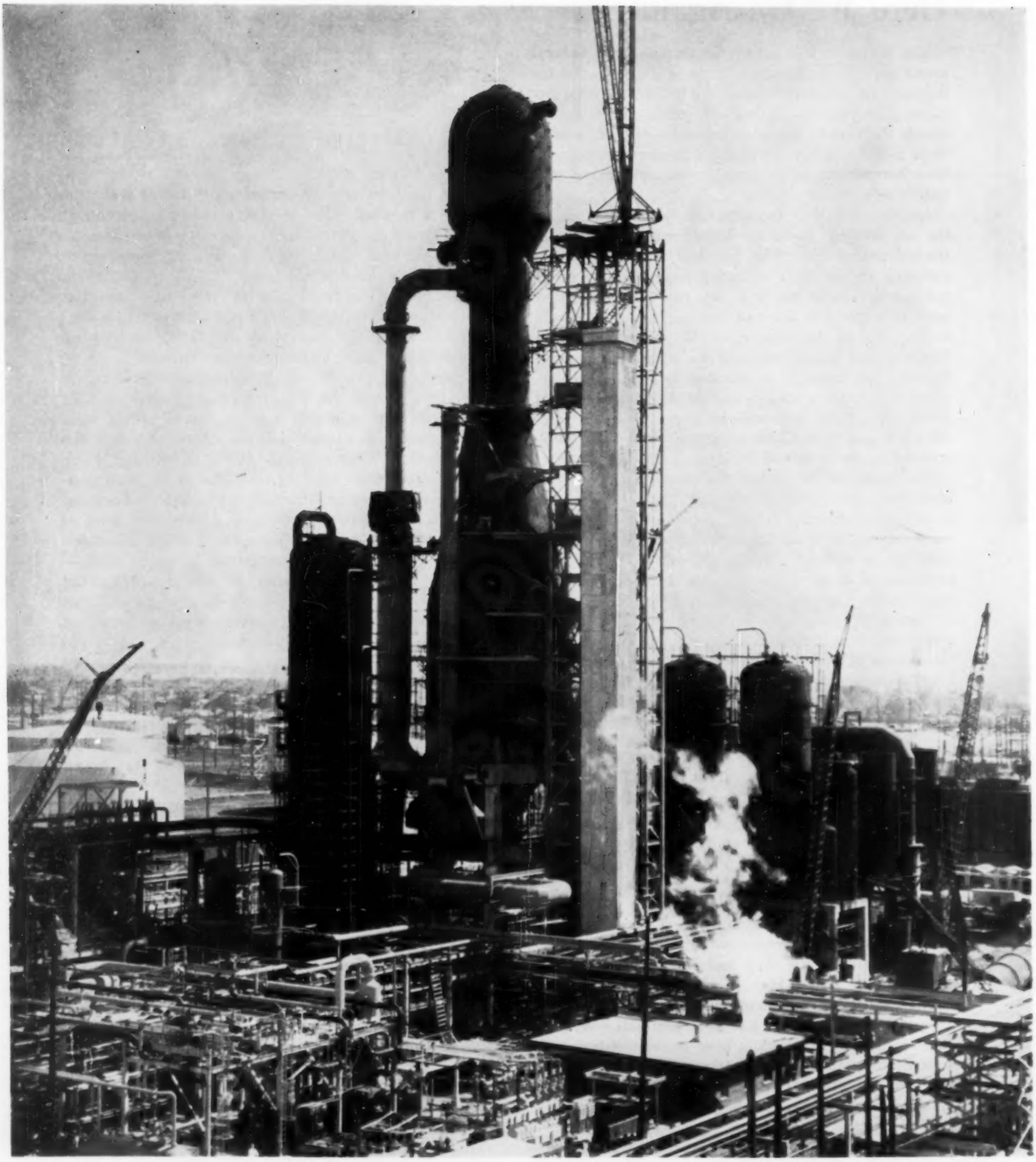
In the Suez crisis it was clearly evident that price had to be used as an incentive to bring out enough oil to meet the extraordinary demand. When Humble was unable to obtain enough oil at its posted price, there were only two courses of action open to its management: It could raise the price in an effort to encourage producers to lift more; or it could sit back and say dolefully, "sorry, we are doing our best but really can't give Europe any more help."

Apparently, neither the Department of Justice nor the members of the jury knew what happened after Humble had decided it ought to try to obtain more oil and not admit defeat in its efforts to aid in the emergency. What happened is the same thing which takes place after every similar change in price posting in this industry. Others in the business were faced with a choice: They could meet the Humble price or refuse to do so. But, if they refused to pay Humble's price, they knew there would be one sure result—loss of crude from producers who would switch to the higher-price company, or shut in their wells and wait for a better price if physical connections were not possible. So they raised the price.

Of course, the price spread to retail stations very quickly. The same thing happens when beef prices rise at Chicago or steel prices at Pittsburgh. In this case, however, the price of motor fuel did not stay up. Unlike crude, there were ample supplies of gasoline. So competition brought the market down to a lower level.

Some fuzzy minded people in government have been trying for years to take the position that it is a crime to meet competition. But that is a difficult thesis to maintain in the United States. The Federal Trade Commission thought Standard of Indiana should not protect its business against price raiders. And now the Justice Department seems to think that crude buyers in Texas should have let Humble take their supply of crude by standing by without meeting the bid. It is time for Washington to realize what actually happens in a free market. Once this is understood, there should be no more "Mother Hubbard" cases brought without genuine evidence of law violation.

Either you have to set up machinery under which every price is regulated from well to gas pump, or you must permit competitors to raise or cut prices. They must be free to take such individual action as they think best to get more business or retain the business they have. No one will maintain that companies should sit around a conference table and set prices, or that markets should be divided by agreement. This was not done during Suez—and the Department of Justice cannot prove that the law, as we now know it, was violated.



New silhouette in Petroleum Refining: This new design fluid catalyst cracking unit dominates the horizon at a Gulf Coast refinery. When placed onstream this month, it will handle 55,000 barrels daily of cracking stock. The unit was built by Foster Wheeler Corp. for a large Texas refiner.

Automatic digital process control

Digital process controllers must justify themselves on the basis of improved quality or yield of higher-value products. Labor costs usually are not lowered, and fixed investment is not involved. High-volume processes involving valuable products are easiest to justify.

by Dr. Joseph Manildi

THE DAY of the automatic computer-controlled refining process is very nearly here. Some day late this year at the Port Arthur, Texas, refinery of The Texas Co., a catalytic polymerization unit will go on-stream under the direction of a digital control system. It will be the advent of genuine automatic process control—the kind of control meant by the term "automation."

The Port Arthur control system was designed by engineers of The Thompson-Ramo-Wooldridge Products Co., working with The Texas Co. engineers. It employs the RW-300 digital control computer, designed and built by The Ramo-Wooldridge Corp. The new installation will provide operating proof that automatic, digital control of refining processes is not only possible, but practical and profitable. Petroleum refiners today are concerned with how to employ automatic control of their processes for maximum benefits, and what effects the development of automatic control will have on the refining industry.

It is apparent to us that many refiners are already deeply interested in the potentialities of automatic control systems. Since the introduction of the RW-300 computer last year, we have discussed automatic control with nearly every major refiner in the United States, and have received requests for information from many foreign countries. Several of the earliest studies conducted by The Thompson-Ramo-Wooldridge Products Co. engineers were studies of refining processes.

Briefly described, an automatic, digital process-control system is a digital computer connected directly to process instruments. The computer reads the instruments, makes control calculation, and adjusts process conditions. The advantages of such a system are these: It is continuous and tireless; it is fast; and it is capable of correlating many data in real-time control calculations more complex than could be attempted in man-directed control systems.

How these advantages can be used to achieve improved operation in a given process can only be determined by a detailed analysis of the process, its objectives, its limits, the benefits to be gained by improved control, and the feasibility of applying an automatic control system to it.

The economic considerations governing investment in a digital control system are the same as for any other capital investment: It must pay for itself. The cost of a typical digital control system, installed complete with instrumentation, is $200,000 to $400,000. Thus the system must increase profits or reduce costs appreciably to achieve a satisfactory rate of return. The petroleum industry, with its large processing units producing high volumes of valuable product, offers many opportunities for profitable use of automatic control systems.

In our studies of petroleum refining processes, we have found that the direct economic benefits of automatic control systems come from the effects of improved control; there is little opportunity for reducing labor costs by installing an automatic system.

There are three kinds of direct economic benefits of improved process control. Where the demand for a product is not limited, either by market conditions or by subsequent processing capacity, an automatic control system can be employed to increase yield or throughput, with obvious economic benefit.

Another benefit is reduced costs of operation. Costs may be reduced through more effective use of catalyst or reagents, reduction of fuel costs, more efficient use of steam or cooling water, and reduced maintenance costs. Maintenance savings may be particularly significant. The computer control system may slow down fouling of equipment, or it can anticipate and avoid instabilities or hazardous conditions which could cause the process to be shut down for repairs.

The third source of benefit is in closer control of product quality. Control of quality can increase profits or reduce costs in a number of ways. In a situation where meeting specifications is a problem, the automatic control system can be expected to reduce the amount of off-specification product run and save the cost of reprocessing. It can also save money by cutting down quality "giveaway." Automatic con-

DR. JOSEPH F. MANILDI is general manager, The Thompson-Ramo-Wooldridge Products Co., Los Angeles. He received the B.S. degree from the California Institute of Technology. Following a year's study at the Harvard Graduate School of Business Administration on a national scholarship, he returned to the California Institute of Technology, where he received the M.S. and Ph.D. degrees in electrical engineering. He is a professor of engineering at the University of California, at Los Angeles.

Dr. Manildi's 16 years of experience include director of research and chief engineer in the field of aircraft and guided-missile instrumentation and jet propulsion, and director of the engineering executive program at the University of California, at Los Angeles. He is the author of several articles, holds three patents, and has two patents pending. Dr. Manildi is a member of the Am. Socy. of Mechanical Engineers, the Inst. of the Aeronautical Sciences, and the American Inst. of Electrical Engineers.

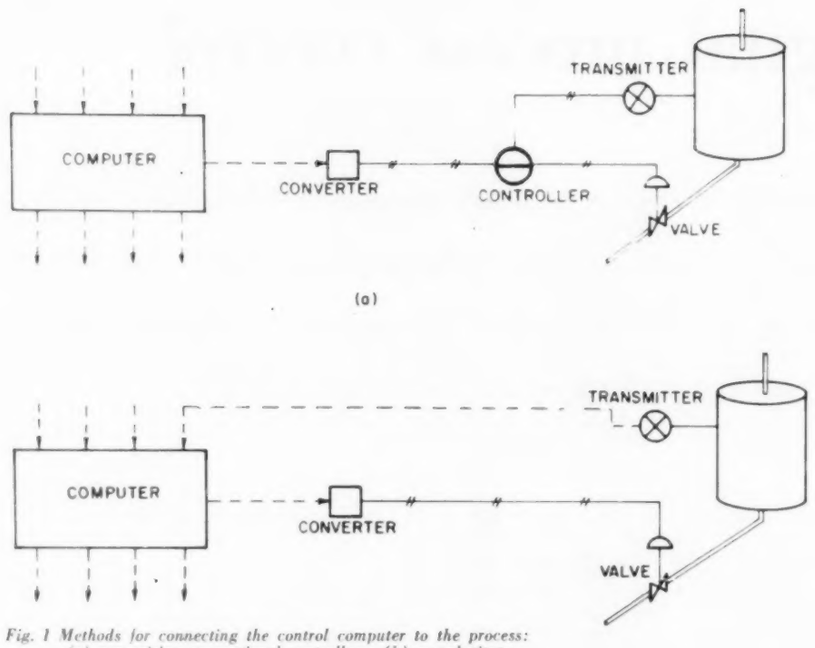


Fig. 1 Methods for connecting the control computer to the process: (a) supervising conventional controllers; (b) as substitute for conventional controllers.

trol may very well permit product-quality standards to be increased, and evaluation of this improvement must be based on an estimate of the market potential for an improved product. The competitive advantages of a higher-quality product is difficult to evaluate, but signficant in the petroleum industry.

The economic benefits achieved by any given control system will come from a combination of these three areas—production, costs, and quality—and will vary as market conditions change. If, for instance, demand for a product drops, the objective of the control system may be changed from maximum output to a lower output at minimum cost. Such changes can occur from month to month, and a digital control system can be readily adjusted to follow them.

In addition to the direct economic benefits of improved control, the digital system offers some advantages to which no exact value can be assigned. The control computer provides a comprehensive log of process data, and can be used for engineering computations while it is carrying out its control functions. Process engineers can employ the data and the computing capacity to gain more understanding of the process and to design improvements in the process or refine the control system.

Planning an automatic control system is an engineering project of considerable scope and great detail. Popular literature likes to refer to digital computers as electronic "brains"; one of our engineers, however, prefers to call them electronic "nincompoops." A computer does only what it is told, and it must be programmed in exact detail. Once it is programmed, it can carry out a fantastic number of operations at electronic speed. But the effectiveness of a control computer depends on the comprehensiveness of its instructions.

The first step in planning a system is ascertaining that the process to be controlled is a likely prospect. The first consideration is economic. In order to justify the investment, it is necessary to choose a process which has a large throughput and adds an appreciable value to the materials processed. There must also be a substantial difference between the current level of operating efficiency and the maximum theoretical efficiency. In addition, there must be adequate data on the process, either from operating records or from studies of other, similar, processes. These data are essential to the development of control equations.

The first step in developing control equations is to set up an expression of the process objective in economic terms. Such an expression equates the profit to the value of product, less the cost of raw materials and the cost of operating the process. Setting up such a profit equation for an intermediate process in a large plant may be difficult due to the assumptions which must be made to establish values for feed and product which may be dependent on other operations in the plant. It may be noted here that, for control purposes, fixed costs need not be entered in the expression. The control-system objective is actually the increase in profit and is, therefore, only affected by variable costs.

The second expression is a list of constraints or limits on the process. Typical restraints are product quality or quantity restrictions, and availability of feed materials. There are equipment limits such as temperature and pressure limits, and compressor and pump capacities. In fact, there are limits on every variable in the process which define the range of possible control actions. In some cases, examinations of these limits may lead to the conclusion that equipment should be modified to permit more effective operation of the process under automatic control.

The third, and most difficult, step in formulating the control equations is the expression of the relationships among the process variables. This study requires a theoretical analysis of the process correlated with operating data. Its end result is a mathematical model of the process which can be used to predict the operation of the process under any set of conditions. An exact theoretical understanding of the process is not a prerequisite to the formulation of such a model. It is a practical model, including all the significant process variables which can be measured while taking into account known inaccuracies in data and allowing for the effects of variables which cannot be measured.

Solution of the control equations requires the fitting together of these expressions to find what settings of controllable process variables (within the constraints of the process) can come closest to achieving process objectives under a given set of uncontrollable conditions. The problem involves complex computations which can only be carried out by a digital computer in the short time and with the accuracy required to direct an automatic control system. The process-control computer must be able to perform such a computation as rapidly and as often as process variables can change. As a matter of fact, it must be able to arrive at solutions considerably faster than the process changes—if only to permit the checking, comparing, and testing routines it must carry out in its control function. Applications studies indicate that the computer will be able to carry out its control routines well within the time requirements of the process and have an appreciable part of its time free for other computing functions.

When the major control equations have been formulated, the next step is to specify the auxiliary computer functions. One of these is data logging. In a digital computer system, the data logged may be as simple as single instrument readings, or they can be the results of computations involving several instrument readings—giving such things as heat-exchanger coefficients, catalyst activity, and yields as direct readings. The computer can also do such things as compute averages and print out total flows over long periods.

The last class of computer functions is the important one of conducting tests and checks on the process, on instruments, and even on itself. These tests may include checking of upper and lower limits of individual variables. They may also include more sophisticated checks involving a number of variables, such as a periodic material or energy balance carried out to detect unusual process conditions. When it detects an instrument or equipment failure or a

hazardous process condition, the computer can be programmed to sound alarms, to notify the operator, or to take appropriate control action to relieve the condition.

When the analysis is completed, the control system must be synthesized to meet the requirements which have been established. Ways must be devised to measure the variables with the accuracy, frequency, and reliability demanded by the control system; means of controlling variables must be chosen; and safeguards must be built into the system.

Any one of these problems leads the applications engineer to wide areas of technology, and the ingenious solutions are many. The author will discuss here some of the ways the unique capabilities of the digital computer are employed to overcome obstacles to direct solutions of problems.

In the measurement of variables, for instance, it is well-known that certain important characteristics of petroleum products cannot be measured directly or continuously by present instruments. In the case of a variable which cannot be measured directly, the computer can often derive a value adequate for control purposes from the measurement of several related variables. It can perform such computations as often as a value for the variable is required. The fact that a variable cannot be measured continuously does not exclude it from use in control calculations. The periodic results of sample testing can be fed into the computer, and it can extrapolate values to use in control calculations.

A discussion of the safety checks which can be built into a digital control system brings up the subject of system reliability. From the very outset of the program which led to the development of the RW-300 process-control computer, reliability was a factor of primary importance. It was recognized that the order of reliability demanded of a process-control computer could probably not be achieved in a computer employing thousands of vacuum tubes. The circuits of the RW-300 are designed around semiconductor devices (transistors and diodes). These relatively new electronic devices make possible circuits which have an expected operating life many times longer than circuits employing vacuum tubes. Reliability considerations were primary in the selection of other components, the design of circuits, and the construction of the computer. Twenty-four-hour reliability tests which have been running almost continuously since the first model was assembled last year have borne out the soundness of the design.

A control computer must be able to run continuously for weeks without failure if it is to be useful and economical. But to be acceptable at all, an automatic control system must be fail-safe. Such systems can be designed. One of the most effective safeguards in an automatic system is the manner in which the computer makes control adjustments. In systems designed today, the computer is not connected directly to the devices which make control adjustments.

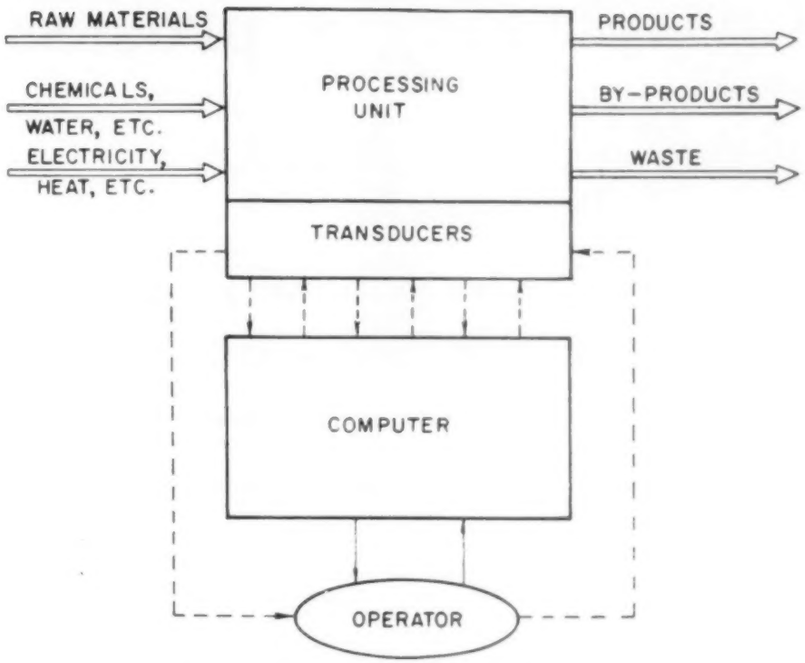


Fig. 2 -Schematic Diagram of a Computer Control System.

At the present time, most of these variables are maintained at a set point by single-loop controllers. In making control adjustments, the computer signal resets the set points of the single variable controllers, and the controller makes the correction in the variable. Thus, in the event of a complete failure of the computer, the process is maintained at the last setting; or, in a more sophisticated system, gradually returned to a known safe state.

The effect of computer errors can be minimized in a number of ways. The computer can be prevented from taking drastic control action on the basis of faulty computations, by being restricted to making adjustments in modest increments and monitoring the effects of the adjustments. A part of any computer program is a detailed self-checking routine which amounts to a test problem with a known answer. The computer can also detect errors in instrument readings, or failures in other parts of the system, and take a variety of corrective actions as well as notify the operator.

The discussion thus far has treated the effects of automatic control systems on individual processes. There is no doubt that automatic control will have profound effects on the operations of entire plants and the entire refining industry as knowledge becomes more widespread and applications multiply. The very nature of the digital computer—its computing capability and ready adaptability to new sets of conditions—indicates that refinements in automatic control will come very rapidly once the new systems are installed. Thus long-range predictions about the effects of automatic control will probably turn out to be short-range predictions.

Among the effects which can be fairly readily predicted is the possibility that capital investment in relation to product output will be reduced. One source of saving is in reduction of storage capacity. As the interrelation of processes becomes regulated by computer control, the need for intermediate storage will decline. Another reduction in investment may be possible when computer reliability is improved to the point where it surpasses that of single-loop controllers and the computer is connected directly to actuating mechanisms. This would permit a significant reduction in instrumentation. A third possibility is that process units can be reduced in size or cost as control is improved. A process which could be designed on the basis of a very closely controlled feed (from another automatically controlled process) could, very conceivably, be less complex and costly than one which must accommodate wide fluctuations. Some reduction in labor costs may also be possible in a plant where there are several processes controlled by computers and a single operator can supervise three or four computers.

The strongest effect on the refining industry may come when automatic systems are turned to processes which have not been sufficiently perfected, because of difficulties in control, to permit their use in manufacture. There are undoubtedly many such processes in research laboratories throughout the petroleum industry today. The industry is today operating processes which would not have been possible except for the control methods and devices developed only a few short years ago. Automatic control can be expected to bring even greater changes. END

Engineering a process with a computer

Segments of refinery processes have been programmed for a computer so that they may be used independently to solve local problems or integrated in any desired combination into a master program embracing a complete process design. Result is that optimum conditions can be established for the proposed process in a very few days.

by M. G. Kesler and Marvin M. Kessler

NOVEL programming techniques written by The M. W. Kellogg Co. make it possible to use an Electrodata computer as an engineering aid in the solution of most process design calculations. Programs for bubble-point and dew-point determinations, equilibrium flash calculations, material and heat balances, absorber- and stripper-tower calculations, etc., have been written in such a way as to enable the engineers unfamiliar with computer language to use these programs either independently or as part of a reiterative scheme dictated by the process flow sheet. These programs have now been integrated into the company's process engineering procedures so that the computer can be used directly by the engineers to calculate a completely arbitrary "light-ends" unit of a refinery.

As a result, the time required for the process design of some units has been reduced more than five fold, while the quality of the calculations has increased. Engineers have been freed from excessive routine and semitechnical work, and use their talents and professional skill to evaluate different process schemes and conditions, and to determine the economic and operating optima of a unit. The flexibility and versatility of this new computer program are being expanded for other units and types of calculations—with the ultimate aim being the process design of a completely arbitrary refinery flow scheme.

The application of the computer to process design calculations at Kellogg began with the programming of a complete material balance around the absorber-stripper system of a fluid cat-cracker recovery unit. The flow scheme chosen for that program is given in Fig. 1.

A solution of this system by hand is done by trial-and-error of first assuming the mole ratio of liquid to vapor in the flashes and absorbers, calculating the composition of each stream, and checking the assumptions. Further checks have to be made on the recovery of the heavy key and the rejection of the light key; the lean oil of the secondary absorber and the assumed stripping vapors are readjusted accordingly, and the calculation repeated. The relatively large amount of internal recycle caused by the recontacting of the primary absorber bottoms and the strippings further complicate the calculations. Indeed, the choice of this particular flow sheet for programming on the computer was motivated in part by the complexity of calculating such a flow scheme by hand.

The input data required for calculating the material balance on the computer consists of: (a) the composition, in moles per hour, and the properties of the net fractionator overhead (F); (b) the composition of any extraneous streams, or of additional lean oil included in the flow scheme; (c) the temperature and pressure in the drums and the absorbers; (d) the approximate stripping factors to be used in the stripper calculations; (e) the required recovery of the light and heavy keys in the system; and

M. G. KESLER, with M. W. Kellogg Co. since 1956, is a process engineer who specializes in computer work. For the past two years he has programmed process engineering calculations on the computer.

Mr. Kesler obtained three MIT degrees—a B.S. and an M.S. in chemical engineering, and an M.S. in biochemistry. He also did work at MIT's fuels research laboratory. Prior to his Kellogg association, he had been with Atalntic Research Corp., engaged in rocket combustion research. He co-authored for the American Rocket Socy. the paper entitled "Rotating Flame Stabilizers," published in *Jet Propulsion*.

MARVIN M. KESSLER, with M. W. Kellogg Co. since 1956, is in the process development division engaged in developing techniques for the solution of engineering problems on digital computers. Previously he had been with Shell Oil Co.

Mr. Kessler holds a B.S. degree in chemical engineering from MIT and an M.S. in applied mathematics from Harvard. He is a member of Am. Inst. of Chemical Engineers, Assn. for Computing Machinery, and Operation Research Socy. of America.

(f) the number of theoretical trays in the absorbers and the stripper.

The procedure followed in the solution of the problem on the computer is similar to that done by hand. The results given by the computer consist of the composition of each stream in terms of moles, pounds, and gallons per hour, and the amount of cycle oil needed in the secondary absorber to meet the specified recovery of the key components. A sample sheet of the output information is given in Fig. 2.

The complete solution of such a problem by hand requires approximately five days; the comparable calculation on the computer takes only 20 min, and is at a fraction of the cost of the manual solution. This being the case, it is now possible to investigate alternate operating conditions and arrive at the optimum process design of a unit within a few calendar days. Thus, in the early use of the program, seven material balances were calculated around the flow sheet shown in Fig. 1 to find the operating conditions most attractive to a customer. The variables studied were: (a) the temperature in the fractionator overhead condenser; (b) the temperature and pressure in the high-pressure separator; and (c) the amount of additional lean oil in the primary absorber. The choice of the optimum operating conditions resulted in savings to the customer of 12% in investment cost over the case which had been originally selected for design. The cost and time required for a similar study in the past, without a computer program, would have been prohibitive, and could not have been undertaken.

Similar studies have since been made on other cat-cracker recovery units and optimum operating conditions selected on the basis of: the cost of utilities in a given area, the nature of the fractionator overhead product and side streams, customer requirements, investment payout time, etc. In the first year of its use, more than 100 material balances were calculated on the computer using this program—with as many as 20 material balances for a single revamp unit.

The successful integration of this program in the process design of cat-cracker recovery units prompted a study of its possible expansion into other types of units and flow sheets. It soon became apparent that the adaptation of the existing program to other flow sheets would involve extensive reprogramming and constant readjustment of the programs to fit a given change in process design. The decision, therefore, was made to write a general program which would translate information supplied by the process engineer in the computer language; write automatically the computer program for the particular flow sheet, on the basis of the information from the engineer; and instruct the computer to execute the program of calculations in the printing of the results. The requirements of such a program were that it be flexible to handle any conceivable combination of flow and conditions in a process unit, any of a number of sets of technical data, and any additional computer program of unit operations to be written in the future. It was further required that the input information to be supplied by the engineer be simple and limited to only those items which are needed for a similar hand calculation; and that criteria for convergence, tests for recovery, and methods of adjustment of variables, in order to arrive at the unique solution, be general so as to apply to any flow scheme. While being general, such a program had also to be efficient in the use of computer time—adapting its methods of reiteration according to the particular problem. All these requirements have since been met successfully.

Dr. J. H. Rickerman, chief standards engineer and head of computer operations at The M. W. Kellogg Co., seated at the computer console: A high-speed tape printer and an automatic typewriter—both used to print out computer results—are to his left; the company's computer is in the background.

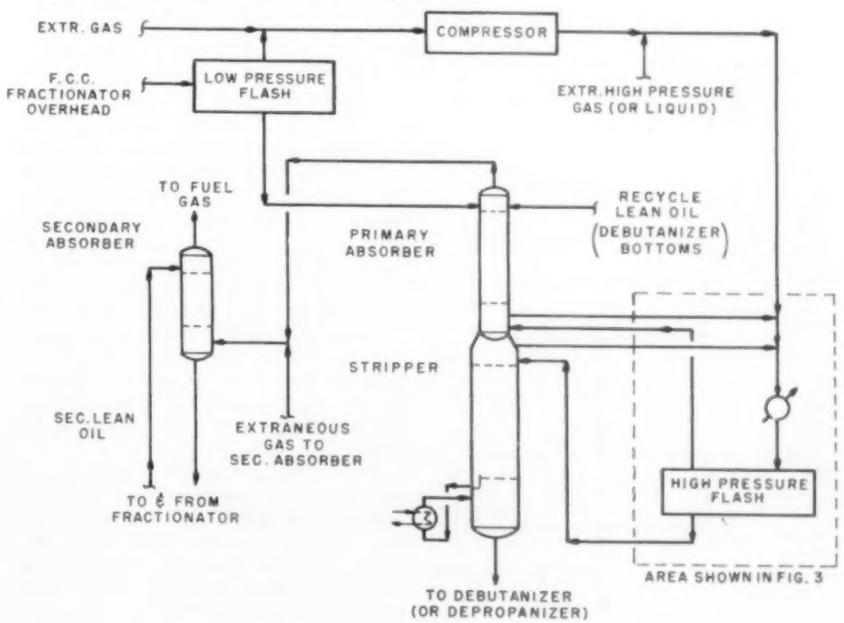
It was noted that the basic elements of the original program—such as the addition of streams, equilibrium flash calculations, and absorber-tower calculations—could be made internally independent and used repetitively in any flow arrangement. These basic elements could be considered analogous to the unit operations in a refinery such as junction points, flash drums, and towers. These elements became the building blocks of a general computer program, and they were provided with simple yet flexible linkages. These, in turn, were to be supplied by a master program in accordance with the flow scheme in the unit. A different flow arrangement would involve a change in the linkage of the master program, while the main body of the program would be unaltered.

The program now in use consists essentially of three parts:

1. The interpretive portion which reads in the data, and form sheets supplied by the engineer translating the information into computer commands and writing a master program for later execution by the computer.

2. A master program which links the various unit operations of the plant in a way predetermined by the engineer and the interpretive routine.

Fig. 1 Absorber-stripper system of FCC recovery unit programmed for electrodata computer of The M. W. Kellogg Co.



Process Flow Diagram—Junctions

__ Job Ident. _____

1 Sheet Number

*2 Operation

3 Number of Streams to be Comb.

4 Result—Stream Number

5 Streams to be Combined

6 " " " "

7 " " " "

8 " " " "

9 " " " "

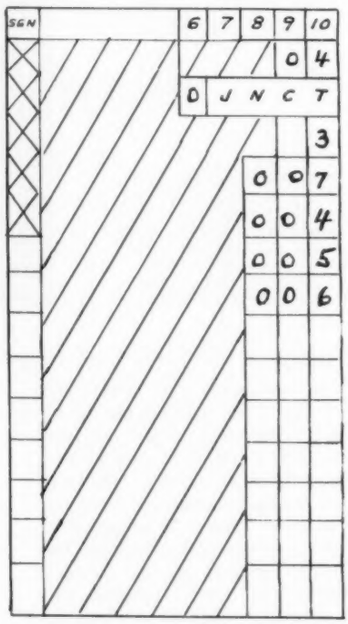
10 " " " "

11 " " " "

12 " " " "

13 " " " "

14 " " " "



* Code

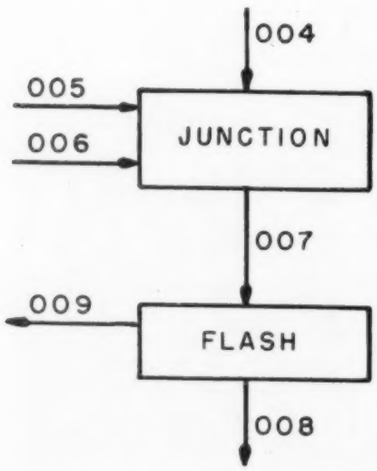
0—Simple mixing

1 Phase and temperature determination

Note: If a stream is to be subtracted put—in sign column
First stream must be positive.

Fig. 4 Computer data form for the junction of two or more streams.

Fig. 3 Schematic diagram of computer operations for the calculation of a section of Fig. 1: The streams are identified numerically (see also Fig. 4 and 5).



3. The main program, which consists of various independent elements representing, in essence, the unit operations in the refinery. Among these are: absorber- and stripper-tower calculations, flashes, bubble-point and dew-point calculations, junction of streams, heat balances, reactor calculations, and a program for estimating the fractionation of trace and intermediate components in a tower when a split between the light and heavy keys is specified. Included are also various tests for convergence and recovery, and programs for printing out the information.

Since these independent elements are used often in the problems submitted by the engineer, and since any of these calculations take one minute or less on the computer, they have been incorporated in the reiterative scheme described above. Other programs for process-design calculations already written are now used independently, but can be incorporated in the reiterative scheme as the need arises. Among these are:

1. A program for calculating the condensing or evaporating path of a hydrocarbon or hydrocarbon-water mixture: This program can also calculate a complete condenser circuit such as a fractionator overhead condenser system.

2. A program for the calculation of liquid loads and the overall heat balance of a fractionating tower.

3. A program for calculating the loads, and the inlet and outlet conditions of either single- or multi-stage compressors.

4. A program for tray-to-tray calculations of a tower.

The list is not exhaustive, but it indicates the scope of the project discussed here. It is obvious, for instance, that the programs listed above comprise the very basic tools used by the process engineer in the design of any unit and, by effective use of these programs, the engineer can solve most of the process-design calculations on the computer. It should also be observed that the process engineer is free to use the computer by means of this program for less extensive calculations of any part of a unit—although the shorter the manual calculation, the less practical it becomes to use the computer.

The data to be submitted by the engineer for the calculation consists of the list of the composition and properties of all the known streams and of data forms representing each unit operation in the flow stream in the order of operations. As an illustration, consider the high-pressure flash of the flow sheet shown in Fig. 1. The section is shown again in Fig. 3, where the streams leading to and from the flash have been identified numerically. To calculate the section, it is required, first, to combine all the streams leading to the flash; and, second, to flash the feed. The two data forms to be filled out by the engineer, for the two operations (junction and flash), are shown in Fig. 4 and Fig. 5. These forms are then translated by the interpretive routine in computer language, and a master program is automatically written which links the two operations—and also, in the case of the flash, finds the equilibrium constants at the specified temperature and pressure. Tests for convergence, corrections for the Watson characterization factor of the resultant liquid, and test for recovery of specified keys for the calculation of the complete flow sheet shown in Fig. 1 are automatically included in the program. When the calculation is completed, the results are printed in tabular form, as shown in Fig. 2—the composition of each stream being given in the order of increasing identification number of the stream. The data submitted by the engineer are processed by the computer operators without the intervention of either the engineer or the computer tech-

nical staff. Tests are included in the program to detect major omissions or mistakes in the data supplied by the engineer.

Two case histories of the profitable use of the program to date follow:

Case A—Process-Design Study of a Desulfurizing Unit: A customer requested the design of a desulfurizer utilizing an unspecified quantity of hydrogen-rich gas from a reforming unit. Since the composition of the makeup gas is known to vary with the age of the reforming catalyst, it was necessary to consider the effect of a gas leaner in hydrogen than that specified by the customer on the design of the unit. It was also desirable to vary the quantity of the makeup gas to the unit, the amount of recycle gas in the system, the temperature and pressure in the system, and the effect of H_2S removal in the vapor stream. Altogether, 17 cases were calculated on the computer, evaluated on the basis of investment cost and profitability, and the results presented to the customer. The selection of the optimum design conditions by the customer was thus made extremely simple, and detailed design of the unit was completed within the time usually required for the design of a single alternate by hand.

Case B—Study for Improved Operation of an Existing Cat-Cracker Recovery Unit: Difficulties were encountered by a customer in the operation of a cat-cracker recovery unit when operating with synthetic catalyst instead of natural catalyst for which the unit had been designed. Remedial steps taken by the customer allegedly alleviated the difficulties; however, the customer requested calculations to confirm his findings. The operating conditions were duplicated, and the results calculated on the computer. While confirming that the new operations conditions should improve the stability of the system, the results also showed that the loss of valuable components in the tail gas as a result of the different conditions were extremely heavy. Further study was made on the computer of 12 different flow and operating conditions to determine the least expensive means of improving the operation. An analysis of the material balances showed that the liquid load on a few key trays in the absorption tower might, under certain conditions, be excessive. It was, therefore, recommended to the customer that those trays be replaced. The recommendations were carried through, and the unit has since been operating without difficulty.

Those are some of the proven benefits of the project. But, in a wider sense, the use of the computer for process design enables The M. W. Kellogg Co. to reduce to a fraction the time and cost of process engineering calculations, and thus serve its customers better and faster than in the past. It also allows the company to use the technical knowledge and the creativity of the engineer more effectively than in the past, in order to examine old flow sheets and to invent new ones, while putting the burden of routine work on the machine END

Process Flow Diagram—Flashes

Job Ident.

	6 7 8 9 10
1 Sheet Number	0 5
*2 Operation and Code	0 F L S H
3 Feed Stream Number	0 0 7
4 Liquid Product Number	0 0 8
5 Vapor Product Number	0 0 9
6 Flash Temperature—°F	100
7 Flash Pressure—psia	200
8 Watson K of Liquid Product (Approx.)	11
9 V/L (approximate)	1
10 Heat Input—BTU/Hr.	

* Code Number for Flashes

0—Pressure and Temperature Given—No Heat Balance

1—Pressure and Temperature Given—Product Enthalpies Calc.

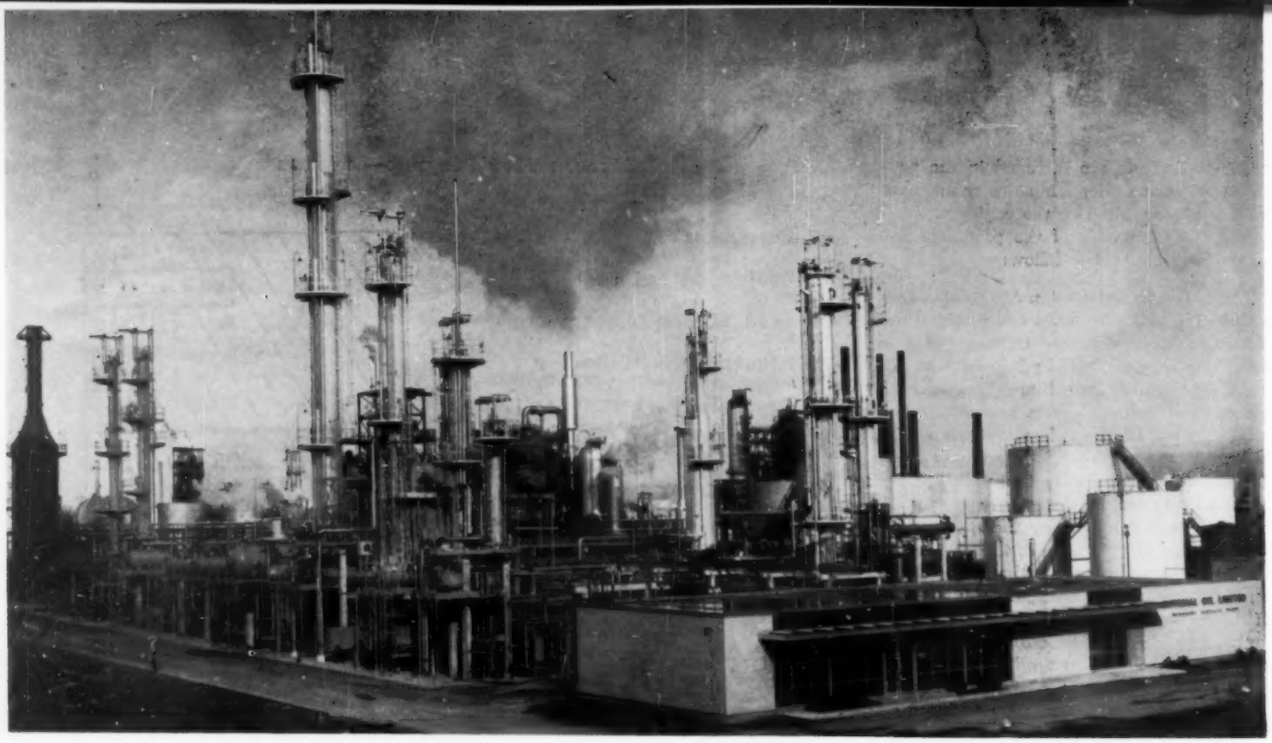
2—Heat Input and Pressure Given—Calc. Temperature

3—Heat Input and Temperature Given—Calc. Pressure

Fig. 5 Computer data form for equilibrium flash calculation.

	MOLS	LBS	GALS
INERTS			
CO2			
HYDROGEN			
METHANE			
ETHYLENE			
ETHANE	13 20	396 00	127 33
H2S			
PROPYLENE			
PROPANE	44 10	1940 40	457 64
I BUTANE	36 10	2093 80	445 49
BUTYLENES			
N BUTANE	103 60	6008 80	1233 84
I PENTANE			
AMYLENES			
N PENTANE	183 60	13208 18	2533 70
HEXANES	418 40	37639 26	6611 50
HEPTANES	261 90	27373 79	4384 01
OCTANES	83 40	9952 96	1512 84
NONANES			
DECANES			
C11			
C12			
C13			
C14			
C15			
TOT INERTS	380 60	23647 18	4798 00
HYDROGEN	763 70	74366 01	12508 35
TOT C1 C5			
TOT C6 PLUS			
TOTAL	1144 30	98613 19	17306 35

Fig. 2 Output form of computer calculations: Composition of a stream of Fig. 1.



Overall view of Imperial's detergent alkylate plant: Left foreground shows alkylate fractionators; right foreground, the polymer fractionators.

Canada's first detergent alkylate plant

by David H. Stone

DAVID H. STONE is a chemical engineer in the operations group of Imperial Oil Ltd.—chemical products department. After graduation from Loughborough College, England, he worked for some years with English chemical firms before emigrating to Canada. Mr. Stone was with Imperial Oil Ltd.—engineering division—before joining the newly formed chemical products department as a design engineer.

Imperial Oil Limited employs two-step process to convert propylene to dodecylbenzene at Canada's first detergent alkylate plant at Sarnia. Propylene is polymerized to tetrapropylene in the primary step, following which the polymer is reacted with benzene in the Friedel-Kraft synthesis.

DETERGENT alkylate (commercial-dodecylbenzene) joined the list of chemicals produced in Canada when Imperial Oil Ltd. started up its first petrochemical plant last fall. The initial shipment of product to one of the major Canadian soap manufacturers highlighted two years of intensive activity on the part of Imperial's newly formed chemical products department—activity embracing the fields of market research, economic evaluation, process design, market development, manufacturing, and sales.

Sarnia, a rapidly expanding refining and petrochemical center located on the St. Clair River across from Port Huron, Mich., was selected as the most desirable location for the "detergent alkylate plant." Propylene-rich feed stock is obtained from Imperial's refinery operations. Other advantages are an abundant supply of river water and electric power; byproducts can be blended into refinery gasoline and middle-distillate pools; the chief marketing areas for the main product are close at hand; and existing dock facilities make it possible to move products by water.

Detergent alkylate is further processed by soap and chemical manufacturers to the corresponding sulfonate. This chemical is the active ingredient in several types of synthetic detergents on the market today. Other ingredients such as phosphates, silicates, fatty alkanolamides, sodium carboxymethyl cellulose, sulfates, and sometimes solubilizers make up the balance of the detergent. Their purposes are manifold—imparting such qualities as foam stability in hard water, prevention of soil redeposition, control of alkalinity, and improved detergency.

The rapid growth of the synthetic detergent market in recent years is due, among other things, to the improved formulations which make them popular in household products. The low cost and high quality of detergents whose active ingredient is dodecylbenzene sulfonate have made them attractive to the manufacturer, and their continued use in industrial and household applications would seem to be firmly established at the expense of soap.

The total Canadian consumption of synthetic detergents in 1961 has been estimated as 235 million pounds. The projected 1961 requirement of commercial dodecylbenzene to satisfy the anticipated demand for detergent alkylate sulfonate is approximately 30 million pounds per year, which represents the rated capacity of Imperial's plant.

Other products made in this plant include tripropylene, which is employed in the manufacture of nonionic detergents, lube-oil additives, and rubber chemicals; tetrapropylene; and heavy alkylate bottoms from which oil-soluble sufonates may be manufactured.

Description of Process: From propylene to dodecylbenzene is essentially a two-step chemical operation. The first step involved catalytic polymerization of four propylene molecules to form one molecule of tetrapropylene. Other polymers made up of two, three, five, and more propylene molecules

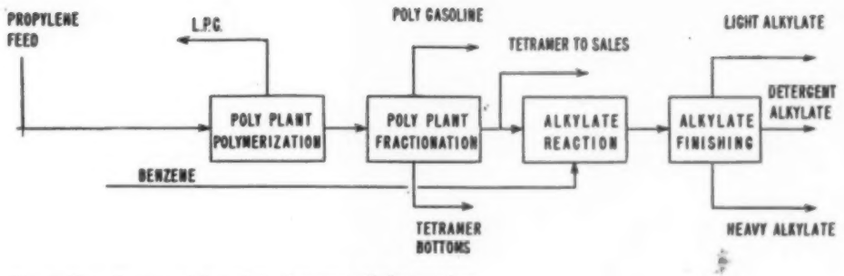


Fig. 1 Flow diagram of Imperial's detergent alkylate project.

are produced at the same time, and fragmentation of the heavier molecules also occurs. The product of reaction, therefore, consists of a whole series of polymers from C_5 through to C_{18} and heavier.

After separation, the tetrapropylene is reacted with benzene in the second process step. This reaction is the Friedel-Kraft synthesis over aluminum chloride or hydrogen-fluoride catalyst, in which the tetrapropylene molecule adds onto one of the carbon atoms in the benzene ring. Other reactions occur in which lower- and higher-boiling alkylates are formed.

Fig. 1 is a simplified flow diagram of the process sequence. A propylene-propane stream is first treated with caustic and water to remove any undesirable sulfur and nitrogen compounds—which, if present, would harmfully affect the polymerization catalyst. The feed, after preheating to reaction temperature, then enters the high-pressure reactor for polymerization.

The reactor products are flashed to remove the majority of the spent propane, and then fractionated in a three-tower system consisting of a depropanizer, a main tower, and a rerun tower. Propane is obtained from the depropanizer for further processing to LPGas.

The light polymers from the main fractionator may be either blended into refinery gasoline tankage, or further fractionated in a two-tower tripropylene unit to produce a material meeting rigid specifications for the chemical trade. The rerun tower produces tetrapropylene as an overhead fraction and a heavy polymer as a bottoms product.

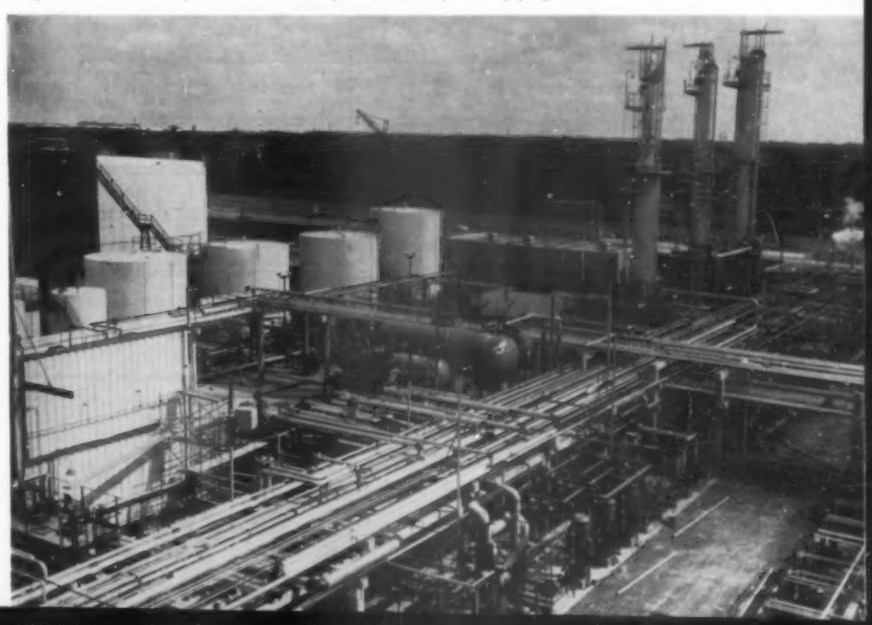
In the alkylation section, fresh benzene, recycle benzene, and tetrapropylene are dried before entering the reactor—where catalyst is added. Heat is removed by means of a pump-around stream which maintains the reaction temperature at the desired level, and intimate contacting of catalyst and feed material is achieved by means of mechanical agitation.

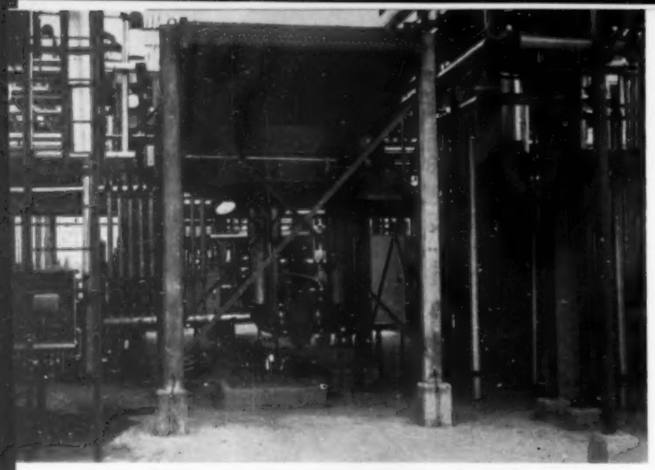
Reactor products are settled to remove spent-catalyst solution, then neutralized to remove any acidity. Excess benzene is recovered and recycled back to the reactor.

Process Control: The detergent alkylate plant receives its feed directly from the petroleum-products refining operations. It must have flexibility to operate over a range of feed rates. Sufficient intermediate tankage has been provided to permit independent control of the key processing steps. The effect of operating difficulties on the yield and quality of the final product is thereby minimized.

The polymerization step is carried out with a phosphoric-acid catalyst. The temperature of the catalyst beds must be carefully controlled to insure a satisfactory catalyst life and optimum product quality. Propane quench, injected between the catalyst beds, absorbs the exothermic heat of reaction.

Imperial's Sarnia, Ont., detergent alkylate plant: Photo was taken when the plant was 90% completed to show complexity of the process piping.





One of the many air fin coolers at Imperial's alkylate plant—first time such a unit had been used extensively by the company.

In the alkylation step, benzene is reacted with tetrapropylene. Hydrogen fluoride, sulfuric acid, and aluminum chloride are catalysts which are employed commercially in the manufacture of commercial dodecylbenzene. The important variables for this reaction—using different catalysts—have been extensively reported on in the literature.

The maintenance of catalyst quality is extremely important. It is essential that water content of the hydrocarbon streams be held at a low level. Excess water will not only destroy the catalyst, but will cause serious corrosion problems.

Proper control of reactor temperature is achieved through the removal of the heat of reaction by a pump-around stream. In general, low temperatures produce a high yield of dodecylbenzene, but a slower rate of reaction must be accepted.

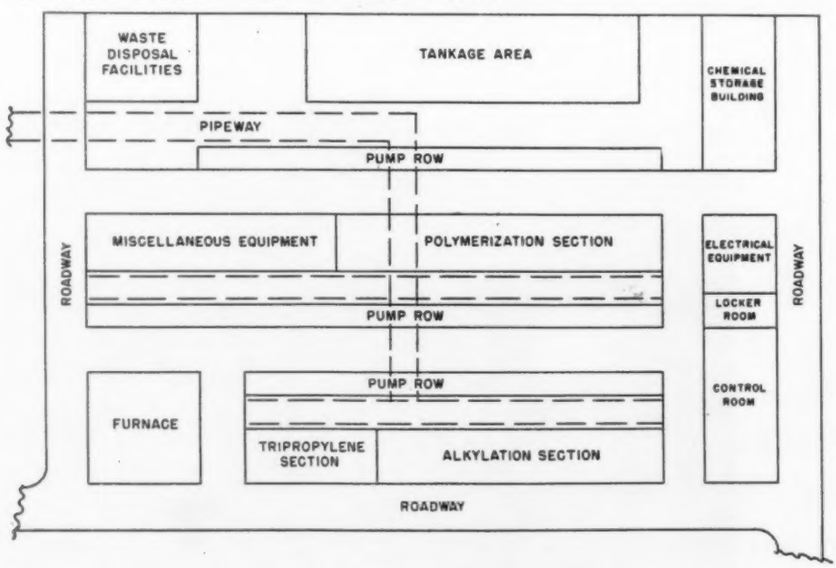
The ratio of benzene-to-olefin in the reactor affects the yield of detergent alkylate. A higher yield is favoured by a high ratio. The improved yield must be balanced against the additional investment and operating costs resulting from the increased benzene recycle.

Dodecylbenzene is subject to thermal degradation. Therefore, vacuum distillation is employed in the final separation. Precise fractionation is required to insure maximum recovery of a product having the desired boiling range.

Product Quality: The laboratory has a major role to play in checking on product quality. Physical and chemical inspections are carried out at critical points in the process. The quality of the finished detergent alkylate is confirmed by the following tests: specific gravity, color, ASTM distillation, sulfur, molecular weight, odor, aniline point, refractive index, flash point, appearance, and dishwashing test.

The majority of these tests are inspections which are widely used in the petroleum industry. One of them justifies special comment: the dishwashing test. This is very important for rating dodecylbenzene as a cleaning agent. As the name implies, the number of soiled dishes which a particular "built" detergent will wash under certain standard conditions is determined. The plates are soiled with a carefully prepared standard dirt, and the built detergent consists of sulfonated and neutralized dodecylbenzene admixed with several of the ingredients mentioned previously.

Fig. 2 Plot plan of equipment arrangement at detergent alkylate plant.



Plant Description: Imperial Oil's plant was built at a cost of approximately $5.5 million, and the construction covered a period of approximately one year. It was designed by the Esso Research and Engineering Co. and by Imperial's manufacturing department—engineering division. The Fluor Corp. constructed the plant.

The main sections of the plant are located on one compact site adjoining the refinery's catalytic cracking unit. It was, therefore, a relatively simple and inexpensive matter to make tie-in connections to supply the new plant with utilities, fuel and feed stock, sewers and waste-disposal facilities. Product tankage is located on site, and new loading lines are tied in with existing refinery rail and dock loading facilities.

The layout of the plant is based on a simple rectangular plan with roadways along three of the four sides. Fig. 2 illustrates the equipment arrangement. Maintenance has been simplified by grouping similar units and leaving adequate working space. In general, the equipment has been arranged so that there is a continuous direct flow of the process stream from the point where the feed streams enter to where finished detergent alkylate leaves the process area.

The accompanying photographs give some idea of the overall size and layout of the plant. Access to equipment and pumps is good from a maintenance point of view, despite the compactness of the layout. The general appearance of the equipment is enhanced by the color scheme in which three basic colors—red, blue, and green—are used for the three principal sections of the plant.

In the control room, the graphic panel—with its array of miniature instruments—is an impressive example of the modern trend towards combining the operating advantages of compactness with the eye appeal of simple lines.

Product Shipping: Facilities are provided to ship product by drum, tank car, and boat. Sufficient tankage has been provided to permit the accumulation of boat cargoes. Special attention has been paid to the cleaning of tanks and loading lines. These facilities were specially treated to remove scale, and then thoroughly cleaned to avoid any chance of contamination. The bulk of shipments of detergent alkylate moves by tank car.

The successful launching of the detergent alkylate project represents a great stride forward—not only for the company responsible, but also for Canadian industry as a whole. In essence, it means more effective utilization of indigenous raw materials, besides introducing more "made in Canada products" into the domestic markets and export trade. For example, by 1961 the net effect on foreign exchange will be in the order of $3.6 million per year. Such a project will lead to others of a similar nature. In the future, Canadians may well look back, and recognize that Imperial's first petrochemical plant was in fact an important milestone in the expansion of the Canadian petrochemical industry. END

Capacity of oil refineries in Japan has increased tenfold since World War II, and petrochemical producing capacity has reached 80,740 tons per year.

FCC plant at Kudamatsu refinery of Nippon Petroleum Refining Co.

Japanese refining capacity to rise 300% by 1975

by M. Ishii*

CAPACITY of Japanese refineries has increased more than tenfold since the close of World War II—reaching 559,900 b/d at the present time. Increase during the past year has been 70,000 b/d as the result of the completion of two large crude topping stills in the Yokkaichi district.

Japan's Economic Council Committee has estimated that the recent rapid rise in national energy requirements will continue, and that by 1975 the country will require a crude throughout capacity of more than two million barrels daily, an additional increase of 300% over the present level.

The Japanese oil industry is far older than is generally thought. In the ancient history book *(Nippon-Shoki)*, there is a record the emperor was presented with "burning water" by the people of the Echigo district (Niigata prefecture) in 668. As early as 1600, the petroleum industry probably was carried on as a commercial enterprise in the Niigata district. Tradition states that there was a refining industry producing kerosine in 1613, but this is considered doubtful. It has been established that a crude distillation unit was built—a very simple kettle—in 1852 at Kashiwazaki in Niigata prefecture.

In the Meiji era (after 1868), the petroleum industry prospered, and some kerosine was imported in 1869. In 1871 the "Coal Oil Company" was established in the Nagano prefecture. This company imported American drilling machines and tried drilling in Nagano and Niigata prefectures. An official report of crude production in Japan was recorded in 1874. The Japanese oil industry thus has a long history—1,290 years as an oil producer and 106 years as a refiner.

In 1888, Samual Co. (later Rising Sun Co.) imported petroleum from Russia, and in the same year Nippon Oil Co. Ltd. was established. In 1900, Standard Oil Co. established International Oil Co. in the Niigata prefecture, and Shell established the Rising Sun Oil Co.

In 1915 Japan's first continuous distillation unit was installed in Akita prefecture, and in 1919 the first gasoline service station in Japan was opened in Tokyo.

According to petroleum statistics, domestic crude production began to decrease gradually after having reached its peak of 471,436 kiloliters in 1915. However, in spite of the depression after World War I, the demand for petroleum products increased so rapidly that Japan was compelled to import both crude oil and products.

Domestic crude production was far short of the growing demand, so most of the crude supply was from foreign sources; and the Japan sea coast, where domestic crude oil was being produced, lost its importance

*Chief, market research section, Mitsubishi Oil Co. Ltd.

as a refining center, and the Pacific Coast became more convenient for transportation between the United States and Japan. Both Standard Oil Co. and Rising Sun Oil Co. imported large quantities of products in competition with domestic companies. Many small oil companies were merged, while Nippon Oil Co. Ltd. and Hoden Oil Co. Ltd. remained as the biggest, and in 1921 these also merged. In 1924, Nippon Oil Co. Ltd. built a refinery—the largest one at that time—in Tsurumi, located between Yokohama and Kawasaki, and installed a cracking unit for the first time in Japan.

Later on, modern refineries were built, and the prototypes of the up-to-date refinery with pipe stills appeared in several places: Yokohama refinery of Ogura Oil Co. (1929); Kudamatsu refinery of Nippon Oil Co. (1930); and Kawasaki refinery of Mitsubishi Oil Co. (1931).

Refineries in Japan as of 1934 were as follows:

Crude Charge	*Number of Refineries*	*(Kiloliters Per Year)*
Domestic crude	31	538,000
Imported crude	25	1,712,000
Both	11	213,000
Total	67	2,463,000

Most of the newly built large refineries charged foreign crude, and the capacity of these refineries was far larger than that of domestic oil refineries. During the '30's, competition in the sales of petroleum products became keen as foreign countries were eager to sell their products in Japan. A price war began when K. Matsukata imported gasoline from Russia and sold it at a low price. As a result, the gasoline price was reduced more than 50% within 12 months or so, and many oil companies with modern refineries were compelled to carry on their business in the red.

In 1934, the *Petroleum Industry Law* was enacted by the government in order to develop and stabilize the important oil industry which was facing a crisis at the time in such circumstances.

Later on, the refining facilities in Japan were gradually improved with equipment for high-quality lubricating-oil manufacturing and high-octane motor fuels. Tōa Nenryō Kōgyō Co. Ltd. was established by joint finance of several refining companies in 1939 with the aim of producing aviation gasoline, and other refining companies were merged for the purpose of stabilization of the petroleum industry. By 1942, refining companies in Japan were merged into the following eight companies and a few very small refiners. (Those in the brackets are amalgamated companies):

Nippon Oil Co. Ltd. (Nippon Oil Co., Ogura Oil Co., Aikoku Oil Co.).

Shōwa Oil Co. Ltd. (Hayayama Oil Co., Niizu Oil Co., Asahi Oil Co.).

Maruzen Oil Co. Ltd. (Maruzen Oil Co., Tōyō Oil Co., Kyūshū Oil Co., Tōhō Oil Co., Yamabun Oil Co., Nippon Motor Oil Co.).

Daikyō Oil Co. Ltd. (Daikyō Oil Co., Edogawa Oil Co.).

Mitsubishi Oil Co. Ltd. (not merged).

Kōa Oil Co. Ltd. (not merged).

Nippon Kōgyō Co. Ltd. (not merged).

Tōa Nenryō Kōgyō Co. Ltd. (newly established).

Besides the companies listed above, there were the Yokkaichi Tokuyama and Taiwan refineries of the navy, and the Iwakuni refinery of the army.

In 1944, the capacity of crude-oil throughput of private refineries was 72,000 b/d, and around one-third of this refining capacity (estimated naval and army refining capacity) should be added to make Japan's total capacity at that time. In 1945, most of the refineries of the armed forces

Fig. 1. Supply of petroleum products in Japan.

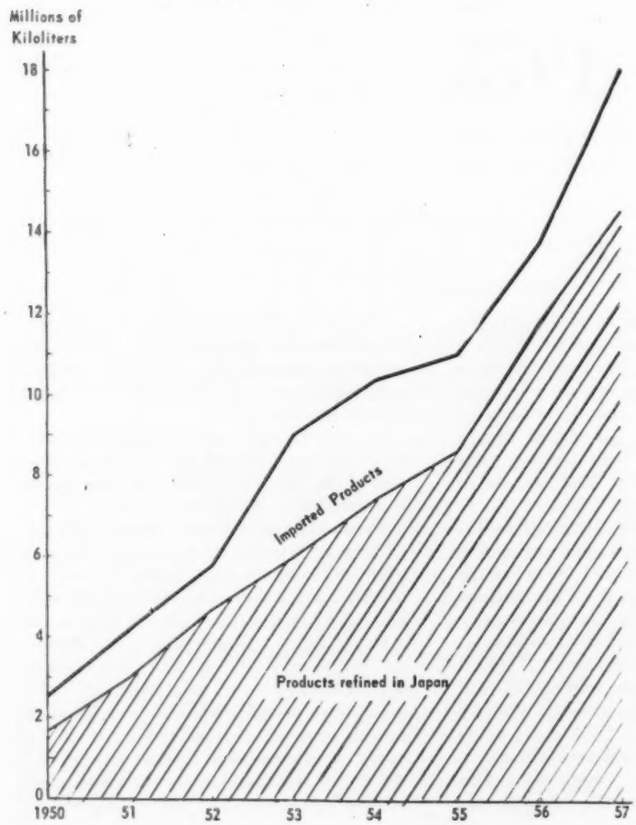
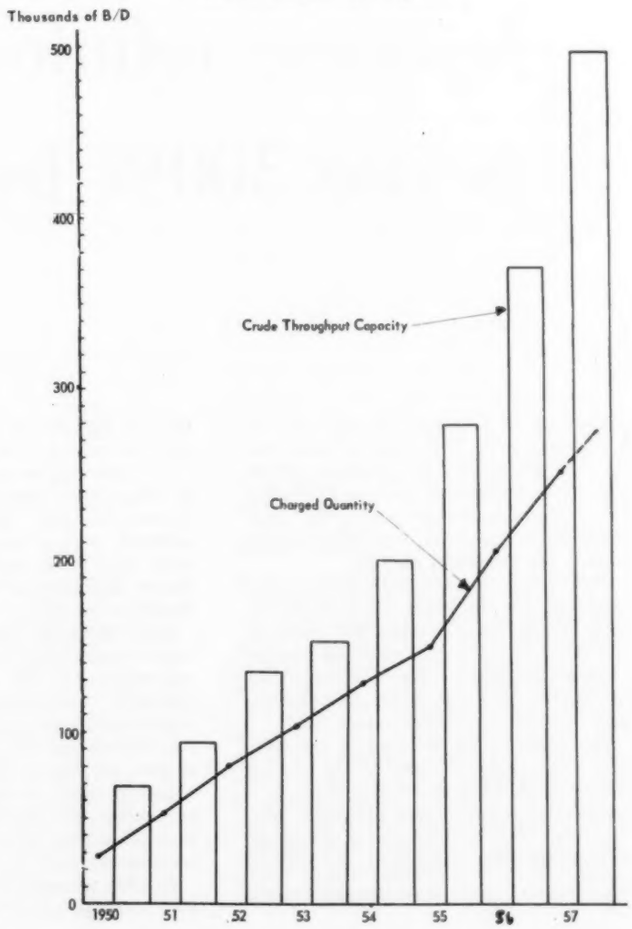


Fig. 2. Crude throughput capacity of Japanese refineries and quantity charged.



and the Pacific Coast private refineries were bombed, and total refining capacity in Japan diminished to 19,200 b/d. Large-scale and modern equipment in these factories was also damaged, while the rest of the refineries were in a difficult condition to operate.

During the four years immediately after the war, repairs and utilization of Pacific Coast refineries were not approved by the military. Therefore, Japan had to depend on petroleum products released by the allied forces and domestic petroleum products to meet the demand.

The Japanese refining industry became active again when the Pacific Coast refineries were permitted to reopen in July 1949. At the end of 1950, refining capacity had recovered to 68,700 b/d—regaining approximately the same refining capacity as prewar within a year and a half.

This recovery, however, was not enough to cope with the rapid increase of demand, and refining capacity continued to grow until recently it exceeded 500,000 b/d. Reconstruction covered not only crude throughput-capacity growth, but installations of catalytic reforming units, catalytic cracking units, and alkylation units in order to produce high-octane gasoline which was required by the progress of motor-car engines.

Solvent-extraction units and solvent-dewaxing units were installed for high-quality lubricating-oil manufacture, while desulfurizing units were installed in some plants to refine high-sulfur Middle East crude.

An important factor in this great advancement of refining facilities within such a short period was that the USA and British companies invested in Japanese companies which became joint enterprises. Mitsubishi Oil Co. Ltd. was the only company which was affiliated with a foreign company (Associated Oil Co.—later Tidewater Oil Co.) in prewar days. Since the war, Nippon Petroleum Refining Co. Ltd. became affiliated with California Texas Corp.; Kōa Oil Co. Ltd., with Caltex Oil Products Co.; Tōa Nenryō Kōgyō KK, with Standard-Vacuum Oil Co.; and Shōwa Oil Co. Ltd., with Anglo-Saxon Petroleum Co. Foreign funds at low interest rates made it possible to expand Japanese refineries. The affiliations covered not only financial support, but technical assistance as well. New Japanese refineries imported major facilities from the USA. This cooperation benefited both Japan and the foreign companies—helping Japan to develop her industry and the investor to hold good crude customers to share in refining profits.

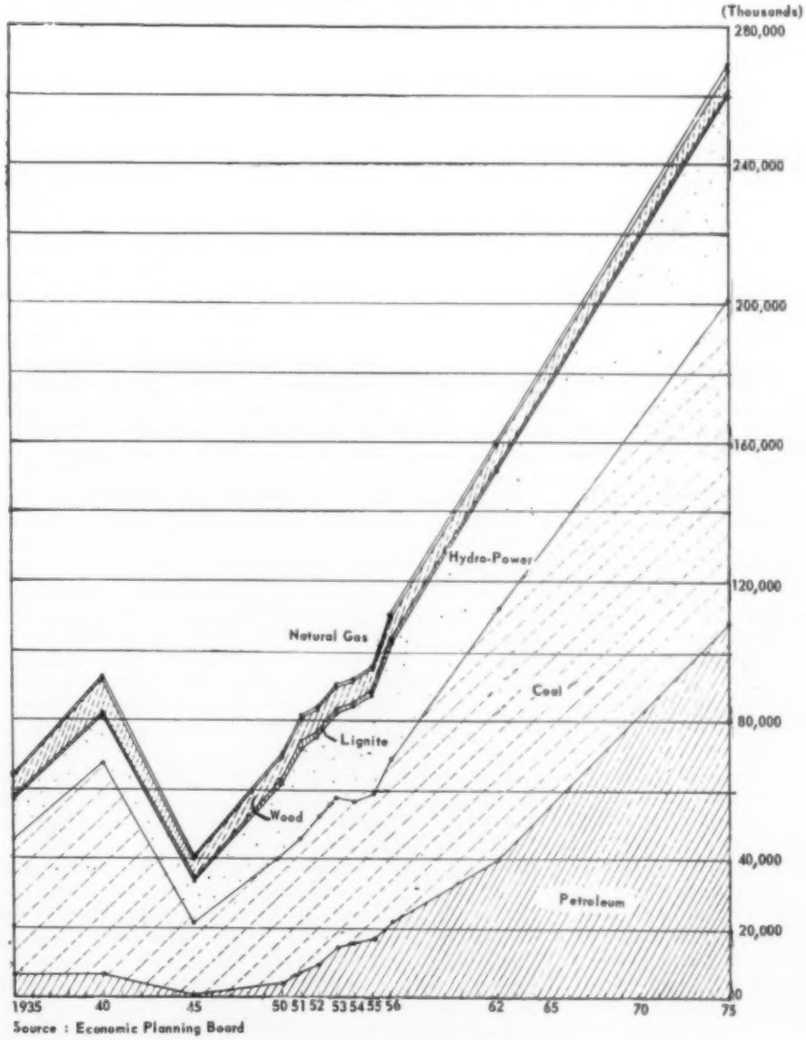
Discussion and study of petrochemical manufacturing were undertaken in Japan before the war, although industry did no plant construction until after completion of reconstruction of refining plants which had been heavily bombed during the war. Because of control by administrative policies and other factors, construction of petrochemical facilities was delayed until later. The following petrochemical plants are in operation at the present time:

Company (Location of Refinery)	*Products*	*Capacity (Thousands of Tons Per Year)*
Maruzen Oil (Shimotsu)	(Sec-butane	2.40
	(Methylethylketone	1.20
Nippon Oil Chemical (Kawasaki)	(Isopropyl alcohol	2.00
	(Acetone	3.50
Mitsubishi (Kawasaki)	(Benzol	6.24
	(Toluol	4.56
	(Xylol	4.08
Idemitsu (Tokuyama)	Sulfur	6.60
Mitsui Oil Chemical (Iwakuni)	(Benzol	8.76
	(Solvent	11.60
	(Polyethylene	12.00
	(Ethylene oxide	4.40
	(Ethylene glycol	4.40
Sumitomo Chemical (Niihama)	Polyethylene	11.0

There are various facilities now under planning or construction—expected to be completed in the near future.

Crude production in Japan remains between 300,000 to 400,000 kiloliters per annum. The Japanese government aims to lift it to one million kiloliters per annum in a few years, but this is not an easy task. On the other hand, energy consumption is still growing because of expanding industries and the improving economic scale. Japan has energy resources both in coal and hydraulic power, but these appear to have reached economic limits recently, in spite of the nation's best efforts. The result is that the energy necessary to Japan must depend upon petroleum to an increasing extent. The Economic Council Committee reported, at the end of 1957, that energy requirements were equivalent to 270 million tons of coal, and the domestic resources produced only 140 million tons of the above. This means that about half of the energy had to be imported. END

Fig. 3 Forecast of Japan's future energy supply expressed as coal-equivalent (7,000 K-cal).



CARLOS L. CORCUERA, manager of the refining department of Petroleos Mexicanos, was born in Mexico City in 1906. Educated in the schools of Guadalajara, Mexico, he is also a graduate of Cambridge University, England, where he spent the four years 1925-29. From 1931 to 1937 he was employed by Cia. Mexicana de Petroleo "El Aguila," a subsidiary of the Royal Dutch-Shell group. After nationalization of Mexico's oil industry in 1938, he was appointed to the position he now holds. In 1951 products pipelines also were placed under his jurisdiction.

Mexico develops refining to meet growing demand

In the past 13 years Mexico has invested $228 million in new refining and transportation facilities, more than doubling capacity. Pemex plants have kept pace during the period with expanding domestic demand

by Carlos L. Corcuera

THE task which befell Petroleos Mexicanos of expanding crude production and refining has been accompanied by the urgency of meeting a continually rising home consumption, but satisfying this demand has been the more exacting because local prices of petroleum products still remain at levels much below true economic worth if measured in relation to other economic factors.

It is obvious that some of the projects being carried out at present might have been undertaken before, inasmuch as they had been planned several years ago; but the low prices of products for the domestic market denied the Mexican oil industry adequate earnings from which to provide for high continuous capital expenditures.

As Senor Bermudez, our general director, frankly stated in his report to the nation, last March: "The (petroleum) industry faces a serious financial problem, because the limitations imposed on its earnings restrict its expansion to keep abreast of the nation's progress, even though our operating and maintenance costs compare favorably with those prevailing in the world petroleum industry" . . . The timely and proportionate growth of the petroleum industry will be impaired as long as the prices of its products remain stationary while the costs of equipment, materials, and services keep on rising not only in Mexico, but in the rest of the world."

In spite of this, Petroleos Mexicanos has managed to invest during the past 13 years US $228 million in new plants and equipment for refineries, absorption plants, and pipelines. Refining capacity in Mexico since 1946 has increased to 322,000 b/d, from 153,000 b/d. Additional facilities are under construction in an effort to cope with future demands.

Total inland consumption grows at a high rate. Now at about 270,000 bbl per day of liquid hydrocarbons, it is 4½ times greater than it was 20 years ago, apart from the fact that, in addition, natural gas is being consumed at present at the rate of 150 million cubic feet per day. But the demand for light and intermediate distillates is advancing much more rapidly than the demand for fuel oil. Whereas in 1938 the requirements of fuel oil amounted to 72% of the total inland consumption of major products, it now represents only 37%. In this period, the daily production of gasoline has risen 62,000 bbl from 8,000 bbl; kerosine to 26,000 from 2,000; diesel oil to 26,000 from 1,600 bbl; whereas the consumption of fuel oil is only 107,000 bbl per day at present, as compared to 43,000 in 1938—a disproportionate growth which, combined with the predominance of heavy crudes, results in a perenial effort to increase the yields of lighter products.

About half of the total consumption is concentrated in the central part of the country, on the table land, more than 5,000 ft above sea level.

With the exception of two small topping units in the Federal District, the oil refineries in Tampico and Minatitlan on the Gulf Coast were, until 1946, the only sources of petroleum products to supply the country's requirements. As the demands increased, the burden on the railways, which had to haul the products from Tampico to the central part of the country, was becoming too heavy; for this reason, the Azcapotzalco and the Salamanca refineries were built.

The Azcapotzalco refinery, in Mexico City, came onstream in 1946 with an initial capacity of 50,000 b/d. Additional facilities were intsalled later, bringing its crude-oil topping capacity to 100,000 b/d. It includes thermal cracking, alkylation, isomerization, gas fractionating equipment, desulfurization of gasoline, and the necessary auxiliaries. Practically all the aviation gasoline required by the country is manufactured in this refinery. Since electric power in Mexico City is limited, a power plant had to be built at Azcapotzalco which now consists of three 5,000-kw turbogenerators which amply provide the required energy to run the refinery. Before the end of this year a 25,000 b/d cat cracker will be completed, with its corresponding feed preparation unit, gasoline stabilizer, and gas fractionating equipment. At the same time, additional alkyation facilities are being installed to increase the production of aviation gasoline and to produce dodecylbenzene for the detergent industry. A polymerization unit will be erected for the production of polyethylene. Total investment, including facilities under construction, will be about US $52 million.

In order to meet the increasing demand for oil products in the central plateau, a new refinery was built at Salamanca, close to an important railway junction situated in the geographical center of the country, in the most heavily populated region, where agricultural and industrial development has

been significant. This refinery was built in two stages: The first stage, completed in 1950, consisted of a 40,000 b/d topping unit, a 5,000 b/d thermal cracking plant, a bauxite desulfurization plant to increase the lead susceptibility of the straight-run gasoline, and a power plant. The cost of these installations, including building and loading facilities, was US $16.5 million.

Later on, lube-oil and paraffin-wax manufacturing facilities were installed, with a total investment of US $31 million. Topped crude at the rate of 14,000 b/d to 15,000 b/d is distilled under vacuum to obtain the light lube-oil streams, and the bottoms from the high vacuum tower are treated in a propane-deasphalting unit for the separation of bright stock and cylinder oils. The distillates are treated in a furfural unit to the required viscosity index, which is usually as high as 95 for the motor oils; then these oils are dewaxed in an MEK-toluene plant and, finally, the lube oils and paraffin wax are treated with clay. Lubricating oils of the highest quality are manufactured in this renfiery, and the production of 2,700 b/d is sufficient to satisfy the present market demands.

Both the Azcapotzalco and the Salamanca refineries are fed with crude oil from the Poza Rica region through separate pipelines which run parallel to each other up to pump station No. 7, located on the eastern mountain range, at about 9,000 ft above sea level. From this point, an 18-in. pipeline runs towards Mexico City and a 12-in. line to Salamanca.

The Poza Rica and San Andres oil fields produce a 30 API gravity crude oil; and the New Golden Lane fields, about 25 miles away, produce a heavier crude (about 18 API gravity). Salamanca is fed exclusively with Poza Rica crude oil; wheeras the Azcapotzalco refinery receives a blend of both, the major proportion of which is Poza Rica crude.

Simultaneously with the first stage of the Azcapotzalco refinery, an absorption plant was built in Poza Rica, and a second one was added later—bringing their total capacity to 220 million cubic feet of natural gas per day. Other facilities were installed to dehydrate the crude and eliminate hydrogen sulfide and carbon dioxide from the gas. The sulfur from the hydrogen sulfide is recovered to produce around 200 tons a day. In order to obtain the maximum recovery of crude oil, a considerable proportion of the purified dry gas is recycled into the reservoir; the rest flows under its own pressure in a 20-in. line to Mexico City. A small 7,000-bbl topping unit is in operation to produce absorption oil and to adjust, if necessary, the composition of the crudes pumped to the refineries.

In the northeastern part of the country, around the town of Reynosa, natural gas is being produced at the daily rate of 240 million cubic feet—130 million of which is exported to the United States. An absorption plant with a capacity of 300 million cubic feet per day has been in operation since 1955. At Reynosa, there is also a refinery with a capacity of 10,000 bbl which processes the crude oil produced in that area.

Large reserves of natural gas have been established in the state of Tabasco, east of the Isthmus of Tehuantepec, where a daily output of about 300 million cubic feet will soon be reached. A gas-absorption plant similar to that at Reynosa has been operating since last February, and a model village—Ciudad Pemex—has been built there, as it is expected Tabasco and the Isthmus of Tehuantepec will become an important industrial region because, apart from its oil and gas potentialities, it is rich in other natural resources, including sulfur. Therefore, it is natural to expect that the isthmus area will develop, in conjunction with the Minatitlan refinery, into one of the most important centers of Mexico's petrochemical industry.

The new Minatitlan refinery, located close to the port of Coatzacoalcos on the Gulf Coast, was completed in 1956. The obsolete equipment which had been there until that time was dismantled. This new refinery has two 25,000-bbl topping units; a cat cracker with a coke-burning capacity of 7,500 lb per hour, which handles around 14,000 bbl of fresh feed per day; a power plant to generate all the electricity required; and other auxiliary facilities. A lubriating-oil unit to produce 800 b/d of lube oils will be in operation before the end of this year.

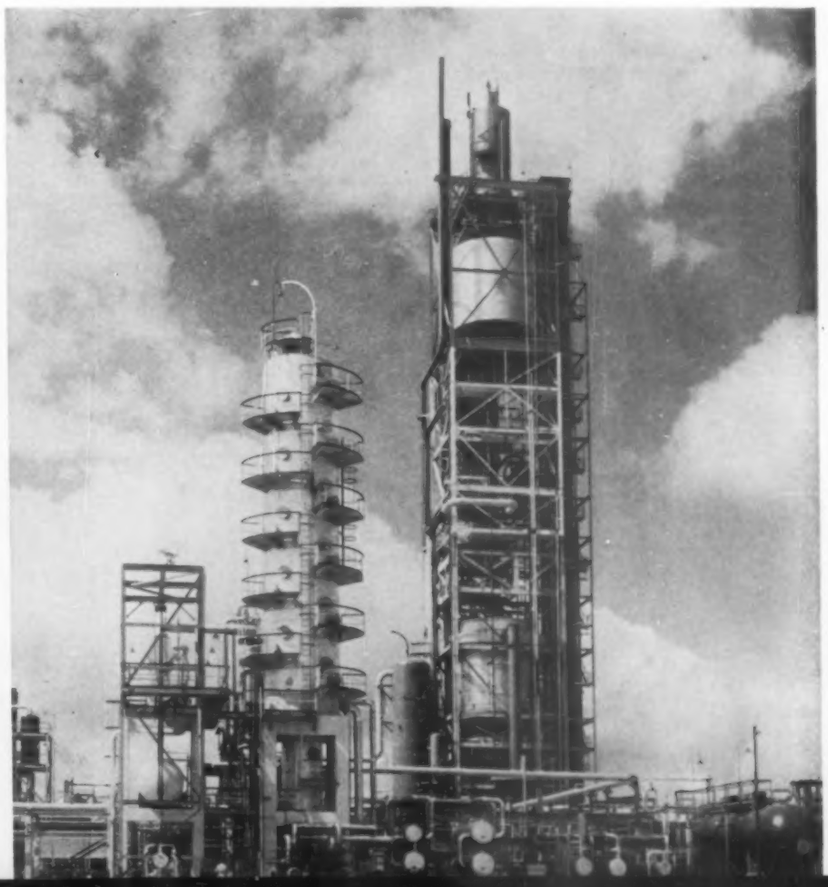
The main duty of this refinery is to supply petroleum derivatives for the Pacific Coast, pumped through a products pipeline which runs from Minatitlan to the Pacific port of Salina Cruz—thus reducing to a minimum the imports of petroleum products which used to be shipped in great quantities from California.

In Tampico, three old refineries are still in operation: the Madero refinery with a capacity of 75,000 b/d, the Arbol Grande refinery with 26,000 b/d, and the Mata Redonda refinery with 14,000 b/d. The Madero refinery is being modernized, and the construction of the new facilities should be completed two years hence.

Transportation is a major problem in Mexico; and, in order to lighten the burden on the railways and at the same time reduce overall costs, the following products pipelines are in operation: the Minatitlan-Salina Cruz pipeline, mentioned before, finished in 1951; the pipelines from Salamanca to Lagos, Guadalajara, Aguascalientes, and Morelia, completed in 1953; and the pipeline running from Tampico to Monterrey, in 1957. The city of Monterrey in northern Mexico is supplied with natural gas from the northeastern fields through the two existing gas lines and a third one which has just been completed by Petroleos Mexicanos.

Future Developments: Mexico is enjoying a period of prosperity and economic expansion. Both industrial and agricultural production are increasing rapidly, and a considerable proportion of the revenue is being spent on developments urgently needed to cope with a population rising by

Thermofor catalytic cracking unit at Minatitlan refinery.



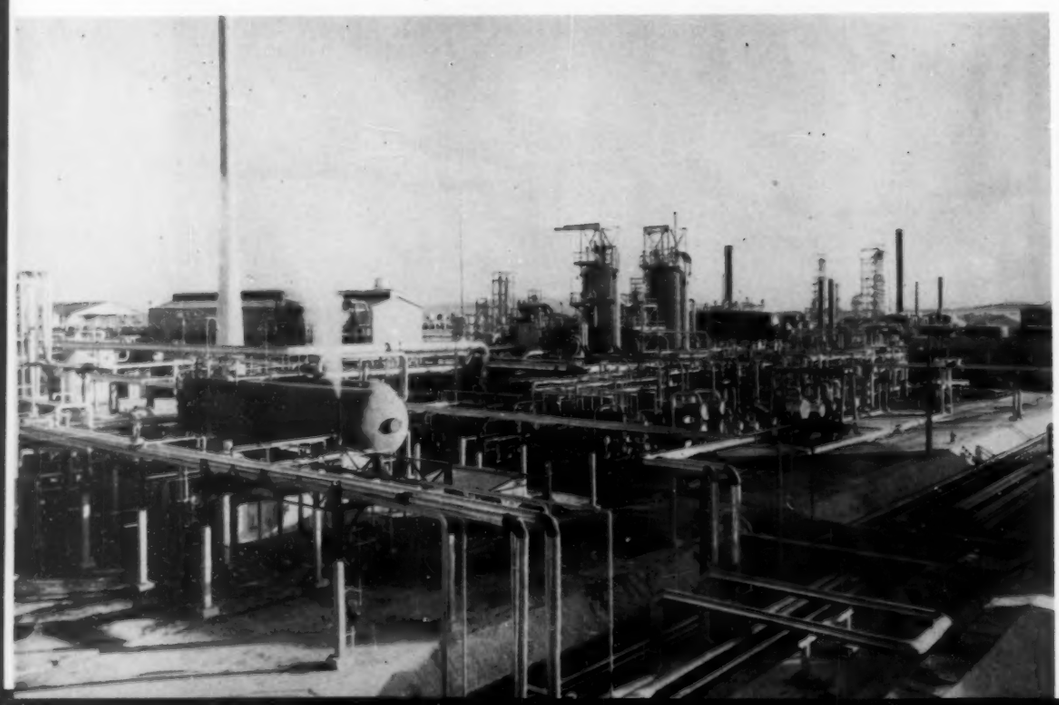
General view of Azcapotzalco refinery in Mexico.

about 3% per annum. But a rapidly expanding economy naturally implies a correspondingly quick growth in the demand for energy; and, since coal is scarce and hydroelectric power is limited, over 90% of the energy consumed in Mexico has to be supplied by the petroleum industry. The primary function of Petroleos Mexicanos is to satisfy this demand.

With the facilities described before, it is possible to process all the gas and crude production of the country—which at present amounts to 272,000 b/d of crude and 490 million cubic feet of natural gas (about 200 million cubic feet of dry gas is returned to the Poza Rica and Tabasco reservoirs). Nevertheless, additional cracking capacity is needed to supply the future demands of light and middle distillates. Furthermore, to take full advantage of the present natural-gas resources of the country, several gas lines are going to be built—the largest one starting from Ciudad Pemex through Veracruz, Cordoba, Orizaba, and Puebla and, finally, to Mexico City. It will have an approximate length of 600 miles, and will be capable of carrying over 300 million cubic feet of dry gas per day. This volume of natural gas will liberate about 50,000 bbl of liquid fuels which will become available either for future inland requirements or for export.

The steady and successful development of crude-oil and gas resources indicates that production will continue to be greater than domestic demand. All of this crude will be precessed in present and future facilities to supply, together with the natural gas, increasing domestic consumption and to export surplus products.

Petroleos Mexicanos has drafted definite projects to meet the required expansion of the refineries. The main problem is to obtain maximum net realization from crude oil and gas. This must be achieved with the minimum investment to provide the neces-



Lube-oil manufacturing facilities at Salamanca refinery.

sary capacity and flexibility of all units involved so that yields may be varied according to demand.

Considering the characteristics of the crude oils available, as well as the future demand of oil products for inland consumption, the following fundamental concepts have been adopted as the basis for the pattern of refinery output in the immediate future.

1. Maximum recovery of gasoline, kerosine, and gas oil must be obtained in the topping plants. The straight-run gasoline should be desulfurized when higher lead susceptability is needed. The upgrading of kerosine must be governed by its market price and required quality. The untreated gas oil is suitable for sale as diesel oil.

2. The entire production of reduced crude should be put through vacum distillation for maximum yield of catalytic feed stock. However, when manufacturing lubricating oils, it is preferable to separate the heavier distillates by solvent extraction to avoid the injurious effects of high temperatures.

3. With the exception of those distillates required for the manufacture of lube oils, all the vacuum gas oil should go to catalytic cracking with the object of obtaining not the maximum yield of gasoline, but the maximum production of cracked gasoline, kerosine, and gas oil. The relative yield of these three products can be controlled by the ratio of conversion and through the fractionating system.

Yields of isobutane and butylene, required for the production of alkylate, grow with the ratio of conversion; but light hydrocarbons and coke deposition increase reducing correspondingly the throughput of fresh feed to the reactor.

Therefore, when the object is to produce as a whole the maximum quantity of motor gasoline and cycle oil, it is better to operate the cat-cracking units at low conversion levels—polymerizing the propylene and butylene. "High conversions" imply the cracking of light and heavy cycle oils already produced, which are almost as valuable as straight-run kerosine and gas oil. In Mexico, a catalytic cracking plant ought to be a factory for the production of gasoline, tractor fuel, and diluents—not an octane-making machine at the expense of good tractor fuel and diluents.

4. From the above, it follows that in the Mexican refineries the feed preparation units and the cat crackers must be designed to take advantage of all the heavy gas oil contained in the crude—with no other limitation than the carryover of metals, such as nickel and vanadium, which should almost wholly remain in the asphaltic residue from the high vacuum tower.

5. Considering that, aside from the heavy distillates to be used for the production of lube oils, all the heavy straight-run gas oil contained in the reduced crude is to be cracked in the catalytic units, the only charging stock left for the existing thermal cracking plants is the asphaltic residue from vacuum distillation. Until a few years ago we thought that vis-breaking of asphaltic residues would not give satisfactory results, particularly in the case of Golden Lane crude; but practical experience has proved that, by adequate control of temperature and residence time in the heaters of the vis-breaking units, it is possible to transform asphalt to fuel oil of 500 viscosity or less. For this reason, some of the existing thermal cracking plants have been remodeled into vis-breakers, and new vis-breaking units will be installed where needed in order to convert all of the asphaltic residue into fuel oil—thereby saving considerable quantities of cycle oil which otherwise would have to be utilized to cut back the vacuum bottoms.

With the foregoing criteria, the yield of light and middle distillates is increased to a maximum—thus reducing to a minimum the production of fuel oil, the shortage of which will be more than compensated by an abundant supply of natural gas. From an economic standpoint, the inland consumption of natural gas to liberate liquid fuels is far better than any imaginable scheme involving the sale of such gas abroad.

The work to be undertaken in the immediate future, to take full advantage of the crude oil and natural gas produced, can be outlined as follows:

The construction of four very important gas lines: one from Ciudad Pemex to Mexico City, already mentioned; another from Mexico City to Irapuato; and, finally, the Saltillo-Torreon and Monterrey-Monclova gas lines.

The modernization of the Madero refinery in Tampico, which has already started, should be completed in 1960: This project will require an investment of approximately US $40 million, and will comprise the construction of two 50,000-bbl topping units, a catalytic cracking plant with a coke-burning capacity of 20,000 lb per hour, capable of handling up to 30,000 bbl of fresh feed at low conversion levels. Feed preparation, gas fractionation, and polymerization facilities will be installed, and later an alkylation plant will be constructed to produce high-grade aviation gasoline in addition to that produced at Azcapotzalco. A new vis-breaking unit to convert the bottoms from the vacuum tower into fuel oil will be built. A power plant to generate the electricity required by the refinery will be ready in a few months.

The next project in the program is the expansion of the Salamanca refinery. An additional topping unit will be built to increase the distillation capacity of this refinery to about 80,000 b/d, and catalytic cracking facilities will also be constructed in order to crack all the heavy distillates left over after the production of approximately 3,200 bbl of lubricating oils and 100 tons of paraffin wax per day (at present 2,700 bbl of lube oils and 90 tons of wax are produced). An additional crude line from Poza Rica will be installed. The capacity of the products pipelines from this refinery to Guadalajara and to Morelia will be increased by the addition of new pumping stations.

The consumption of oil products along the Pacific Coast is growing rapidly; and, in order to supply futureneeds, the Minatitlan refinery will have to be expanded. We plan to build a new factionating unit and a catalytic reformer for the extraction of benzene, toluene, and xylene. A vis-breaker also will be installed. Later, additional topping and catalytic cracking facilities will be necessary; and the capacity of the products pipeline through the isthmus to the Pacific port of Saline Cruz will have to be increased.

This is essentially the program of expansion of the refineries which Petroleos Mexicans is carrying out step by step—which, accompanied by a steady and successful development of crude-oil and gas resources, will guarantee the supply of the nation's future demand for energy. END

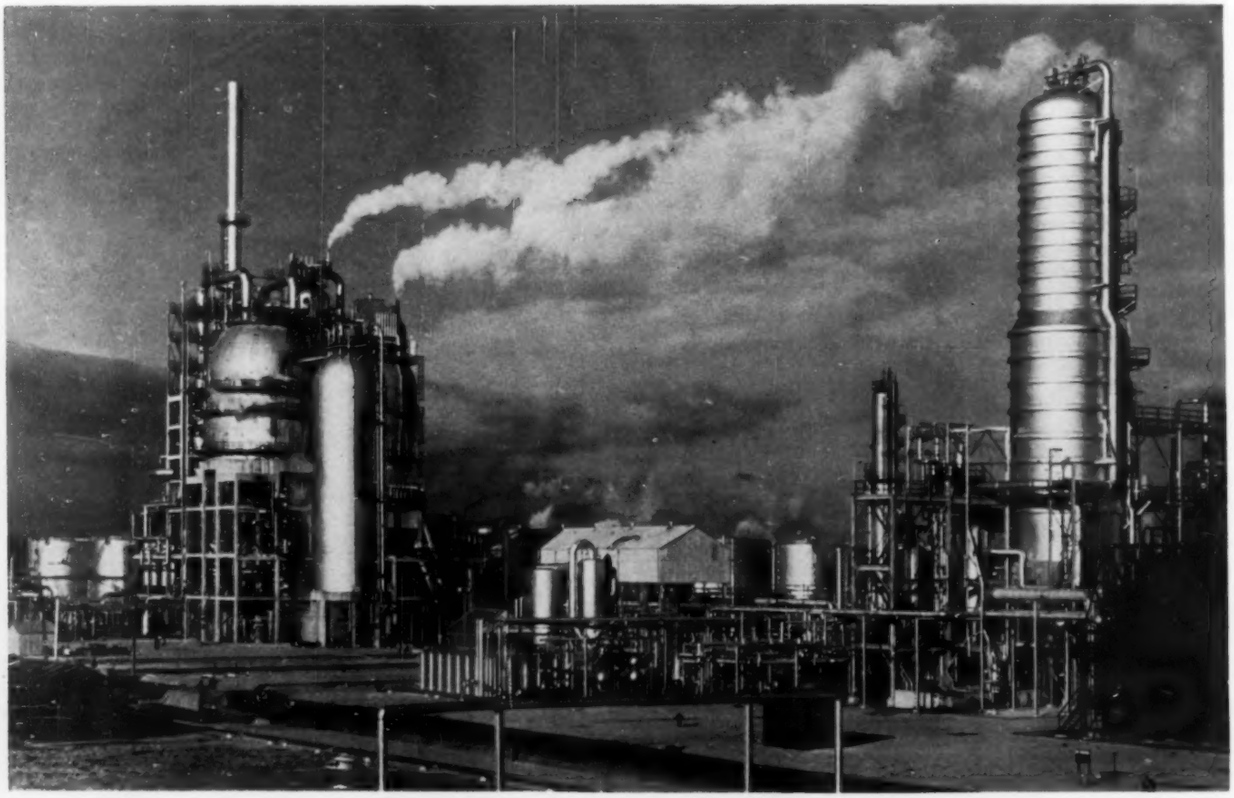
General view of Ciudad Pemex, Tabasco: In foreground is absorption plant and compressor house—capacity 300 mmscfd.

Thermofor catalytic cracking unit at Mobil Oil Co.'s Coryton refinery—only one of its kind in Great Britain: Using a bead catalyst, it also includes the "air-lift" method of circulating the catalyst (Mobil Oil photo).

Refinery expansion

Refinery and petrochemical plant construction centers in consuming areas. Western Germany, The Netherlands, and United Kingdom are engaged in important programs.

General view of catalytic cracker at Esso Petroleum Co.'s refinery at Fawley (Esso photo).



in the western world

by Alan L. Paget

THERE are 43 projects for new refineries and 22 expansion programs now proposed for construction in the noncommunist area outside of North America. The 43 new projects envisage a total throughput capacity of 860,000 b/d. A few of these schemes are tentative, but any which fail to materialize are sure to be supplanted by others not yet announced.

As indicated in Table I, most of the new capacity is proposed for erection in areas of heavy consumption with little or no domestic crude production. Of the total of 142,925,000 tons per year of capacity, 128,595,000 is planned for consuming areas and only 14,330 for producing countries.

In addition to crude capacity, there are numerous projects for petrochemical manufacturing. In the United Kingdom, Esso Petroleum Co. Ltd. will complete a £9 million plant this year for the production of chemical intermediates. The Esso plant is England's largest—with a current throughput of nearly eight million tons per year. Chemical byproducts will include large quantities of ethylene, propylene, butylene, and butadiene.

Butadiene is to be piped directly from the refinery to a new factory nearby now being built by the International Synthetic Rubber Co., which will produce, to begin with, 50,000 tons a year of synthetic rubber. This, the first large-scale rubber-from-oil project in the United Kingdom, will save Britain $30 million a year—a figure which will increase as output rises. As regards the other gases, Monsanto Chemicals, which is also putting up a plant nearby, will draw supplies of ethylene directly from the refinery to make into polythene, a plastic having a multiplicity of uses. Union Carbide also is planning to build a plant close by. In the second place, with the aim of directly meeting Britain's rapidly increasing demand for fuel, a further £13 million will be spent on general expansion, and on new plant and extensions to the jetty which will serve to raise the refinery's throughput to 10½ million tons a year from 8 million. Up to this year, the refinery will have cost £68 million, and every year it will require over a million and a half tons of shipping in continuous service to keep it supplied with crude oil. Every day it will turn out nearly seven million gallons of oil products.

At Esso's proposed new refinery at Milford Haven, West Wales, where 100,000-ton tankers will be accommodated, work was due to start in the last quarter of 1957—to be completed by 1960. With an initial throughput capacity of 5½ million tons, this refinery will employ 1,000 men, and is estimated to cost about £20 million. The company is said to envisage the full development of the 1,000-acre site (implying roughly a doubling of the initial capacity) in eight years or more.

Shell is planning to construct two large floating stages at Tranmere on Merseyside, each of which will be able to accommodate a fully loaded tanker of up to 65,000 tons—bringing crude for the refinery at Stanlow. As part of the expansion program, the further facilities at this refinery will include an £800,000 Udex unit for making a special avgas blending component from Stanlow's £3½ million Platformer, and is due to go onstream about the middle of the year. At Shell Haven, on the north bank of the Thames estuary, a vast program of expansion is proceeding, in which is included the construction of a new crude-oil unit which is expected to be completed by the summer. The combined throughput of Shell's four refineries exceeded 180,000 b/d.

With the completion later this year of a major scheme of expansion, The British Petroleum Co.'s Kent refinery on the Isle of Grain, on the banks of the Medway, will be one of the most modern and comprehensive refineries in Europe. A new distillation unit, the first major plant to come onstream in the refinery's $90 million expansion project, was commissioned in February this year. When the entire scheme is complete, the refinery will not only be capable of a throughput of more than 140,000 b/d compared with 90,000 b/d previously, but will also be able to produce 2,600 b/d of aviation gasoline.

This project constitutes the predominant expansion being undertaken by British Petroleum at its United Kingdom and European refineries, but new units to increase throughput capacity and improve the quality of products are being built at several other installations. In all, 21 new processing units will be commissioned at the Kent refinery this year. The main items in the expansion program may be classified as (a) plant to increase crude-processing capacity; (b) plant for the manufacture of aviation gasoline. For crude-processing expansion, there is one 90,000 b/sd distillation unit, one 12,000 b/sd stabilizer, two 8,000 b/sd copper-chloride treatment units, and one 8,000 b/sd kerosine acid-washing unit. Associated hydrogen-sulfide recovery and sulfur-production plants will have a capacity of 45 tons of sulfur per day. Associated with the aviation-gasoline production will be one 10,000 b/sd catalytic reformer—with provision for *in situ* regeneration of the catalyst, if required; one 12,000 b/sd thermal reformer; one 2,250 b/sd alkylation unit using sulfuric acid; one 500 b/sd Udex and one 900 b/sd isopentane unit—a single column 160 ft high with ripple trays. Additional treatment plant and an acid-recovery unit are also being installed.

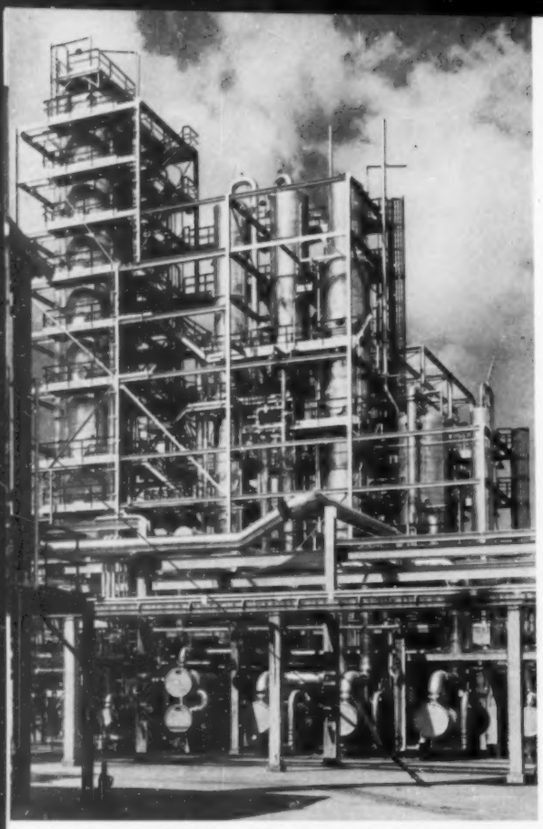
Cooling-water intakes from the Medway estuary are being expanded, as is also the oil and water separation plant for purifying cooling water discharged into the river. As the bulk of the refinery's production goes out by sea, two new jetties—each capable of berthing a supertanker—have been built. More than 100 new storage tanks have been erected.

The South Eastern Gas Board is building a large catalytic oil-gasification plant adjacent to the refinery. Using its own Segas process, the plant will make 18 million cubic feet of town's gas a day, as a first stage, and will take some 1,400 b/d of oil feed stock directly from the refinery by pipeline.

At The British Petroleum's Grangemouth refinery, in Scotland, work began last November on a $18 million expansion scheme to increase processing capacity to 3,200,000 tons a year from 2,200,000 tons. For this purpose, a new crude unit is being erected which will replace part of the existing distillation plant. Associated with the new unit is a copper-chloride treater, a de-ethanizer which will increase the quantity of propane produced, and gas-oil and kerosine treating units. A new boiler is to be provided, and a 2,250-kw generator driven by an experimental gas turbine is to be installed in the power house. The erection of a number of tanks of various sizes and extensions to present product loading facilities will complete the project.

Mobil Oil Co.'s Coryton refinery, on the north bank of the Thames estuary, was originally expected to process a million tons of Middle East crude in its first year of operation. Towards the end of 1957, however, this figure had risen to 1.5 million tons, and by the spring of this year 1.75 million tons were being refined as the result of modifications to the equipment.

The thermal reformer has been adapted to undertake different operations from those for which it originally had been designed, and its place has been taken by a new catalytic reforming unit which uses a platinum-type catalyst, and takes substantially the same feed stock as did the old thermal reformer; but it produces a higher-octane gasoline, and gives a higher percentage yield of product. One result of its coming into operation has been that Mobil is now marketing a petrol of super



Furfural unit at Mobil Oil's Coryton refinery, where oily compounds are removed from lubricating oil by furfural extraction.

quality in the 100-octane range to meet specialized demands.

The increased throughput of crude oil has rendered the original jetty capacity insufficient to meet the present needs of the refinery; and early last year a new deep-water jetty, capable of berthing 33,000-ton tankers, was put in hand, and is now in operation. An interesting feature of the new jetty is a novel hose-handling system, the first of its type to be installed in Britain. The hoses are wound on 18-ft-diameter reels which are rotated hydraulically as the vessel rises or falls under the combined effect of tide and change of buoyancy.

Last year, a new technical services laboratory was completed—furnished with the most modern apparatus for testing all petroleum products and fully equipped for carrying out process-development work for the refinery. Harking back to the crisis period 1956–57, it may be of interest to record briefly how Coryton was affected by the Suez incident. As all crude oil processed at Coryton is of Middle East origin, the closing of the canal and the cutting of the Iraq pipeline at the beginning of November 1956 seriously curtailed supplies. Fortunately, the refinery held very high stocks of crude at the beginning of the emergency, and this enabled it to operate at nearly full capacity during the first two months. From the beginning of 1957, however, it became necessary to reduce throughput to about 60% of the maximum capacity; and, but for the assistance of Socony Mobil in the United States, the reduction would inevitably have been even more severe. As a result, Coryton did not have to change its source of supply. Instead, one of Socony Mobil's refineries in the United States turned over to crude from the Western Hemisphere and released its importation of Kuwait crude to Coryton.

Ireland: Within the past year, the news has come that Ireland is to have her own refinery. Despite the balance-of-payment difficulties which have necessitated drastic import restrictions, oil consumption in the republic continues its steady growth. The greatest increase of all was in the demand for fuel oil, which rose by 42% in 1955–56—the principal users being the power stations. The main users of gas oil are the railways. There are more than 200 diesel-electric locomotives and rail cars with an annual consumption of 20,000 tons. At present, Ireland's oil needs are met solely by imports of refined products, valued in 1956 at over £18 million. Construction has now begun on a refinery at Whitegate Bay, County Cork, to be owned jointly by Shell-Mex and British Petroleum, Esso, and Caltex. The plant—including a marine terminal and deep-water pier for tankers up to 45,000 tons—will cost some £13 million. It is expected to begin operation by the end of 1959, and that the eventual annual capacity will be two million tons. Construction and subsequent operation will provide welcome employment and also ease the balance-of-payments situation. With the completion of this plant, yet another European country will have full-scale refinery facilities.

Briefly reviewing the present situation in the United Kingdom, one notes that the fuel position is easier than at any time since the war—with oil refineries working below capacity and coal stocks at their highest level for the time of year. The main reason for this is the government's anti-inflationary measures designed to halt the rise in prices. These measures have necessarily restrained the expansion of the country's economy and, therefore, of its energy requirements. Looking beyond the recession, one must estimate probable future energy demands which can be met only from coal, nuclear power, and oil. Accordingly, oil companies must proceed with their long-range plans to increase their refining, storage, and distribution facilities to take care of the expected growth in demand. This year should witness the addition of no less than 9½ million tons a year to the country's refinery capacity—a jump of about one-third over the end-1957 figure.

The increased capacities of British refineries and the construction of the new refinery in Ireland have already been noted. Looking still further ahead, Esso's new 5-million-ton refinery at Milford Haven should come onstream in 1960; while the long-heralded Caltex plant on Southampton Water may be under construction at that date. Without any further additions, these expansion projects would appear to be well able to satisfy the expected growth of United Kingdom oil consumption up to the middle '60's.

The Netherlands: In continental Europe. The Netherlands figures largely. Towards the end of last year, Esso obtained permission to build a new refinery in the Botlek area, near Rotterdam, with a capacity of 4.5 million metric tons annually. Construction is due to begin this year, for completion in 1960. Caltex, it was announced, is also to build a new refinery in this area, with a capacity of 2.5 million tons, which will be linked by pipeline with its existing 50,000 b/d refinery at Pernis.

BPM's refinery of 11½ million tons capacity at Rotterdam is already the largest in Europe; and a fourth oil port, to be built in the Rotterdam area, will also be the terminal from which supplies will be piped to the Ruhr, where the construction of a new 80,000 b/d refinery will start later this year. A company was formed in April this year, under the name of NV Rotterdam-Rijn Pijleiding Mij., to build and operate a 300-km 24-in. crude-oil pipeline to the German Rhineland refineries at Godorf and Weseling; there will also be a breakout point to link with an existing pipeline to

TABLE 1

FREE WORLD (EXCLUDING NORTH AMERICA): TOTAL ADDITIONAL REFINING CAPACITY UNDER CONSTRUCTION OR PROJECTED[a]

(Approximate Throughput Capacity in Thousands of Metric Tons)

New Capacity to be Built in:	Probable Completion in 1958	For Later Completion	Pending Projects	Total
Middle East	7,200	800	—	8,000
Venezuela	4,000	2,000	—	6,000
Ecuador	330	—	—	330
Total producing-exporting areas	11,530	2,800	—	14,330
Europe (including Turkey)	15,050	52,250	25,850	93,150
Japan	5,570	5,500	1,750	12,820
Other Asia[b]	400	4,750	250	5,400
Hawaii	—	1,750	—	1,750
West Africa	100	—	—	100
Latin America[b]	3,100	12,150	125	15,375
Total consuming-importing areas	24,220	76,400	27,975	128,595
GRAND TOTAL	35,750	79,200	27,975	142,925
New Capacity to be Built for:				
Commercially-owned entities	34,250	64,500	21,475	120,225
Government-owned entities	1,500	12,700	6,500	20,700
Mixed entities	—	2,000	—	2,000
GRAND TOTAL	35,750	79,200	27,975	142,925

[a] Excluding projects whose planned capacities have not been announced.
[b] Excluding producing-exporting areas which are included in preceding part of table.

Gelsenkirchen. The line, which is to be completed in about two years' time, will have an initial capacity of 7.5 million metric tons a year—possibly to be more than doubled later on by the installation of additional pumping capacity. The possibility is not excluded that the Rotterdam-Rhineland line will later be linked with a pipeline running from Marseilles northwards, to provide a trans-European pipeline system from the Mediterranean to the North Sea. It may appropriately be mentioned here that British Petroleum's Lavéra refinery, near Marseilles, has been extended; and a large new distillation unit recently commissioned brings the total refining capacity up to 80,000 b/d. Since the war, the capacity of Lavéra has been raised to the present figure from 10,000 b/d. Before the installation of the new unit, the throughput was increased in several stages by converting and modifying obsolete plant for distillation purposes. The new distillation unit, which has a capacity of 45,000 b/d, will allow a smaller distillation unit to be held in reserve.

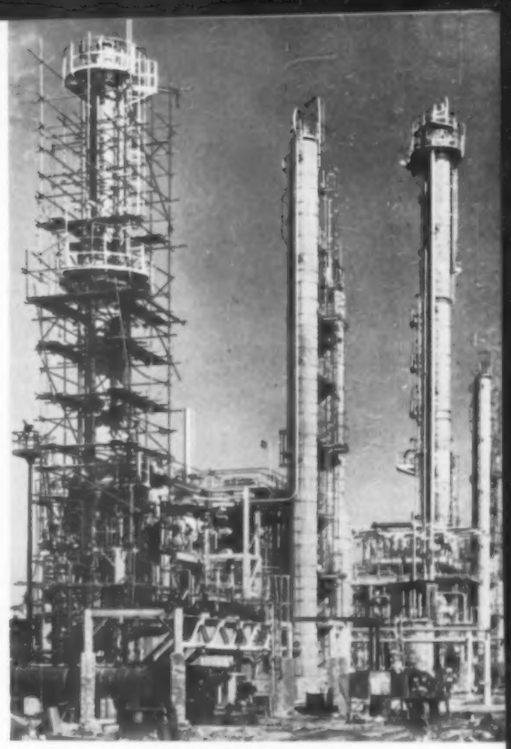
It is now apparent that more refining capacity, more oil exports, and more oil in transport will, in the next few years, bring The Netherlands an even greater interest in the oil trade than it already possesses. In fact, The Netherlands has become the oil entrepôt for a large part of Europe. The seaports are enjoying a boom of activity, which may become even more lively as the European Economic Community gets into its stride. The new refineries will attract additional trade, as will also the "Europort" expansion scheme sponsored by the Rotterdam authorities—of which the new oil port is an essential part. Within two or three years, The Netherlands refinery capacity will reach about 21 million tons a year, as against 14 million tons at present. It may be noted that at BPM's refinery at Pernis there are important facilities for petrochemicals production, to which a synthetic general-purpose rubber plant is to be added.

An important feature of last year's development was the remarkable increase in the output of local crude oil—which reached 1.5 million tons, as compared with 1.1 million tons in 1956, and about one million tons in 1955—equivalent to about 30% of the country's internal consumption. Most of the crude still comes from the Schoonebeek field near the German frontier, but recent increases are due to the discovery of a number of small fields in the neighborhood of The Hague.

Belgium: In Belgium, the fuel position can be stated fairly simply: The growth of industrial production has intensified the demand for all forms of fuel and power; while the output of coal, which is virtually the only native source of fuel, has failed to keep pace. The country has, in fact, been saved from a fuel famine only by steadily increasing imports of petroleum products. The Ministry of Economic Affairs envisages an increase in requirements to perhaps 44.5 million tons coal-equivalent by 1965, but expects coal production to rise to no more than 34 million tons by that date. It is, therefore, not to be wondered at that the consumption of oil products has risen more than 2½-fold in the past seven years; the increase might have been even greater had it not been for restrictions imposed by the Suez crisis. An interesting feature has been the recent increase in fuel-oil consumption by power stations—to 195,000 tons in 1956 from only 31,000 tons in 1955. Altogether, about 7% of the country's electricity was produced in the former year from liquid fuel.

The supply of petroleum products comes primarily from local refineries which normally depend on the Middle East for more than 90% of their raw material. However, the marketing companies' varying supply arrangements result in substantial imports of products from refineries in The Netherlands and elsewhere, while products from Belgian refineries are marketed in other European countries—notably The Netherlands and Switzerland. The Belgian oil trade is thus integrated into the wider West European oil market, and these ties may become even closer with the formation of the Common Market and, eventually, the European Free Trade Area.

In the early autumn of last year, Belgium's refinery capacity was given as being about 6.5 million tons a year—soon to be raised to some 9.5 million tons as STBP (BP and Petrofina) planned to double the capacity of its Antwerp refinery to about six million tons. At this refinery, a catalytic reformer of 10,000 b/d capacity is nearing completion; while a 10,000 b/d Hydrofiner is also due for commissioning later this year. Esso also has a refinery, of 1.6 million tons capacity, in Antwerp, where there are also four smaller plants. In addition, Shell has a small 150,000-ton refinery at Ghent.

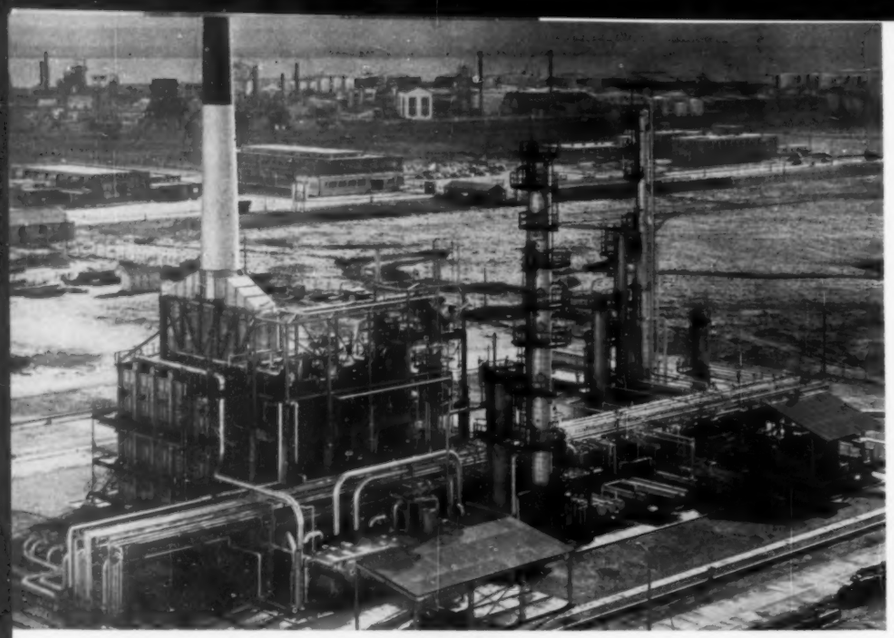


British Petroleum Co.'s Kent refinery: Left to right are C_3C_4 splitter, stabilizer unit No. 2, isopentane unit, and stabilizer unit No. 1 (PB photo).

Despite recent improvements, the port of Antwerp cannot take the largest tankers, but a scheme is being considered to enable nearby Zeebrugge to handle vessels up to at least 80,000 dwt.

In view of the shortage of indigenous fuels and the importance of the Belgian Congo as a producer of uranium, the prospect of nuclear-power production has obvious attractions for Belgium. Some experimental reactors have been built, and there are tentative plans for nuclear power stations to be completed between 1962 and

Foundations for Udex extraction plant at British Petroleum's Kent refinery (BP photo).



New catalytic reforming unit at Mobil Oil's Coryton refinery: Platinum-based catalyst is used to convert low-octane naphtha into high-octane motor fuel.

1967 with a total capacity of 500 mw—equivalent to more than one-sixth of the total present generating capacity. In exchange for uranium from the Congo, Belgium is entitled to receive assistance from the United States and Great Britain on nuclear-power development, while the new Euratom treaty provides for close cooperation with other European countries in this field. In the intervening years, Belgium will have to rely increasingly on petroleum products for its energy requirements.

Sweden: In Sweden, the total inland consumption of liquid fuels last year was slightly lower than in 1956—the decline being caused mainly by the unusual weather and by the restrictions imposed during the Suez emergency; but, if the high standard of living is maintained and nothing occurs seriously to hinder the country's progress, oil consumption—which has risen more than eightfold since before the war—is expected to double within the next 25 years or so.

Virtually the whole of Sweden's oil demand is met by imports—mostly of products. Hitherto about 100,000 tons of shale oil have been produced annually and refined in the State-owned plant at Kvarntorp, some 100 miles west of Stockholm. A new and more efficient type of retort was brought into use at the end of last year, and this will raise output. There is little hope of finding natural crude except possibly in the extreme south of the country, where the Geological Survey Department has carried on an unsuccessful search for several years. Incidentally, the shale deposits now assume a new significance—which, it is hoped, will supply Sweden's future atomic installations. There are three crude-oil refineries in Sweden, with a present combined throughput capacity of rather more than two million tons a year—all belonging to local industrial and shipping interests. Koppartrans (Kopparberg and Transatlantic) owns a refinery with about 1.2 million tons capacity at Gothenburg, while Nynäs Petroleum (Axel Johnson & Co.) owns the other two refineries, viz., a 700,000-ton plant at Nynäshamn near Stockholm, and a small 150,000-ton plant at Gothenburg. Nynäs Petroleum now intends to raise the capacity of its plant at Nynäshamn to 1,800,000 tons—thus bringing the country's total capacity to more than three million tons.

A plant for producing about 100,000 cubic meters (some 3.5 million cubic feet) a day of town's gas by complete gasification of oil is being set up at Stockholm gas works. It will be capable of operating on any kind of petroleum fuel, and is due to go into service by the middle of 1959. Though none of the major oil companies has as yet a full-scale refinery in Scandinavia, Esso will build a two-million-ton refinery on Oslo Fjord—to be completed by 1960—which will also supply its affiliate in Sweden. The refinery will be owned by A/S Esso-Raffineriet Norge, a new associate of Jersey Standard; the estimated cost is about NKr 215 million (£10,750,000 at NKr 20-£), or about $31 million. To begin with, half the output of the refinery will be sold abroad—mainly to Esso companies in Sweden and Denmark—but probably the whole output will be taken by Norway by about 1970.

Denmark: Denmark is alone among the countries of Western Europe in depending on oil for the larger part of her demand for energy—with coal covering most of the balance. Demand has risen extraordinarily rapidly in recent years, having doubled since 1953. All oil and hard coal are imported; but there is a small production of lignite and peat, while the output of hydro-electricity is of the order of 25 million kwh. Nuclear-power development is being studied—the first research reactor having arrived from the USA last autumn.

Most of Denmark's supplies of petroleum products comes from western refineries—mainly in the United Kigndom and The Netherlands. There is little unanimity among experts regarding the prospect of finding oil in Denmark. The country belongs to the same sedimentary basin as The Netherlands and northwest Germany—including Schleswig-Holstein, where crude oil is being produced in relatively modest quantities. The oil pyrolysis plant of A. P. Möller, originally planned to go onstream in Copenhagen a year ago, was due to begin operation in April after major reconstruction to remedy technical troubles. The plant has a cracking capacity of 150,000 to 175,000 tons a year of petroleum fuel, and is to supply nearly 45 million cubic meters of gas to the Copenhagen Gas Works—which is about one-third of its total output. It will also produce some 40,000 tons of gasoline and fuel oils, and appreciable quantities of liquid gas and ethylene.

In assessing the general situation in Scandinavia, account must be taken of the move towards a regional customs union. The four countries concerned—Sweden, Norway, Denmark, and Finland—have already established close consultation on economic and other matters through a joint Scandinavian parliamentary council, and an intra-Scandinavian committee of experts has issued detailed suggestions for the creation of a common market. The cooperation proposed is similar in scope to that of the six Common Market countries of continental western Europe. However, on account of the much smaller degree of duty protection, and also because all Scandinavian countries are deficient in refining capacity, the immediate impact of a common market on the oil business will probably be smaller in Scandinavia than in continental western Europe.

USSR: The situation of the oil industry in the USSR is always difficult to assess, but recent official announcements—which must be presumed to be authentic—have included some interesting figures. Mainly as a result of expansion in the Ural-Volga area, the USSR last year attained a record production in excess of its plan, of about 98 million tons compared with 83.8 million tons in 1956 and only 33.4 million tons in 1949. Mr. Khrushchev recently indicated a production goal for 1972 of no less than 350 million to 400 million tons—implying an average annual growth of at least 9%. During 1958 it was planned to spend 4,000 million rubles on capital investment—35% more than in the previous year. During the year, new refinery capacity will be brought into operation at Gorki, Stalingrad, Perm, and Ferghana; and it is planned to start the construction of major refineries at Krasnoyarsk and Pavlodar—both in the eastern part of the country—and at Polotsk (Byelorussia). About 2,100 km of crude-oil and products pipelines and 2,900 km of gas pipelines will be completed. It is hoped to increase gas production in 1959 by a further 19,000 million cubic meters, and to complete in that year 3,800 km of gas pipelines.

Reports indicate that expansion of refinery capacity has lagged behind crude

production. In general, increased yields of light products are needed; the quality of gasoline needs to be improved, also desulfurization of diesel fuels. The development of the petrochemical industry, too, appears to have lagged behind the ambitious plans laid down at the time of the last Communist Party Congress in February 1956.

Technology: The summer meeting of the Institute of Petroleum, 1957, in the United Kingdom took as its theme "The Influence of Engineering Progress on the Oil Industry." Recognizing the petroleum industry's links with every branch of engineering, the inquiry afforded a closer study of the extent to which the industry's growth is dependent upon the tempo of engineering progress. Briefly, the progress in mechanical engineering has undoubtedly influenced the size and nature of world oil demand; at the same time it has rendered invaluable assistance to the petroleum industry in the solution of the problems it has created. One of the most fundamental of these is, of course, the continual stepping up of crude production. Drilling depths have increased to more than 20,000 ft from 8,000 ft; the power output of drilling rigs to 3,500 hp from 250 hp; and test pressures of casing and drill pipe to 19,000 psi from 1,500 psi. Accordingly, the transformation of the whole refining scene since the interwar years would have been unthinkable without the continual flow of new ideas in both mechanical and chemical engineering. The extent of the past 30 years' progress in the methods of crude distillation is remarkably demonstrated by comparing a continuous-battery distillation plant of 30 years ago wtih a present-day first-stage distillation unit. The throughput of the former averaged 600 tons a day, with a fuel consumption 4½% of the throughput; the respective figures for the modern unit are 10,000 tons per day and 2%. Moreover, the crude was fed to the battery plant by a hand-controlled steam pump, while the present-day counterpart is equipped with an automatically controlled centrifugal pump—feeding at 200 psi to 250 psi pressure through heat exchangers to a single tubular furnace serving a multitude of parallel heating circuits.

By a natural progressive process, such advances blaze the trail towards the advent of the automatic refinery. This was the subject of a paper entitled "New Trends in the Instrumentation of Refinery Processes," which was read to the Institute of Petroleum in London in October last year, by S. W. J. Wallis and D. S. Townsend, of The British Petroleum Co. The main theme is that there has been no fundamental change in principle or application since the first automatic controls for refinery use made their appearance more than 25 years ago. But, if many units of plant are to be operated at maximum efficiency, a fresh approach to instrumentation is needed. In a refinery, at present, the control of product quality is achieved by maintaining a number of related variables—pressures, temperatures, flows, etc.—at the values which experience has shown to give an acceptable product. The general objective is a consistent quality—although it does not follow that consistency of quality gives either the best or the most economical result. In any case, the regulating techniques employed are far from perfect. The control of quality is indirect: The balance of the process can be upset if only one variable gets out of control. The sampling and testing techniques which are needed as a check impose long delays, and the human operator has the difficult task of assimilating information from a large number of variables and of trying to relate these to one another.

The fundamental objective for the future, therefore, must be to evolve a plant which can be operated continuously at the optimum conditions—i.e., making the most efficient use of raw materials, taking into account the types of crude available, the level of stocks, storage facilities, market requirements, and price levels. Moreover, assuming it is possible to establish criteria by which optimum operation can be determined, the aim must be to achieve this result automatically. But before this goal can be reached, more detailed information about plant and process characteristics will be needed, besides techniques for the automatic analysis of the product, and more accurate and reliable instruments than those at present available.

Messrs. Wallis and Townsend believe that during the next decade it may be technically possible for the human operator of a plant unit to be replaced by a "master controller" which would automatically absorb all the data, and work out and initiate the necessary corrective action. Such a controller would incorporate the electronic computer which would receive information about conditions in various parts of the plant; would calculate any necessary corrections, and adjust the desired values of the individual controllers—temperature, pressure, etc.—accordingly. The computer might, however, be substituted for both the human operator and the individual unit controllers, in which case it would send out signals directly to the regulating units. Where process conditions do not fluctuate rapidly, it is conceivable a single computer could be used to govern the operation of a complete plant.

There remains the vitally important question whether, though technically possible, the fully automatic plant would be economically or operationally desirable. It can only be said such a plant would necessarily be complicated and expensive. Therefore, it would have to offer advantages unattainable by other means if it were to prove commercially acceptable. However, it has been established that electrical science—which pervades all the modern techniques of geophysical oil prospecting by seismic, magnetic, gravity, and other survey methods—also provides the prime essentials of instrumentation for laboratory work and the multitude of labor-saving devices for plant automation and remote control which are the key to high productivity in every sphere.

In the preparation of this article, acknowledgment is made to all the major oil companies mentioned, and to the Institute of Petroleum, for the information they have supplied.

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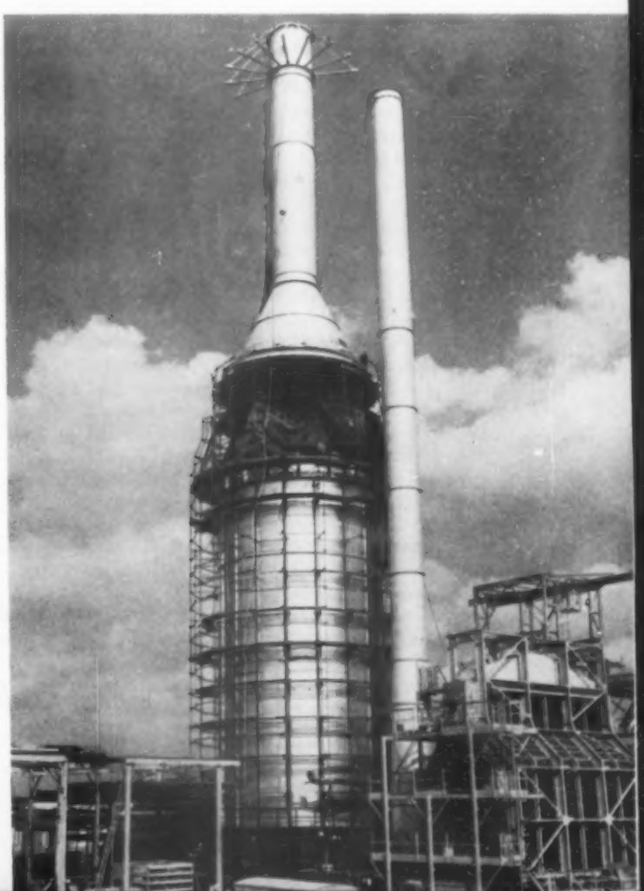
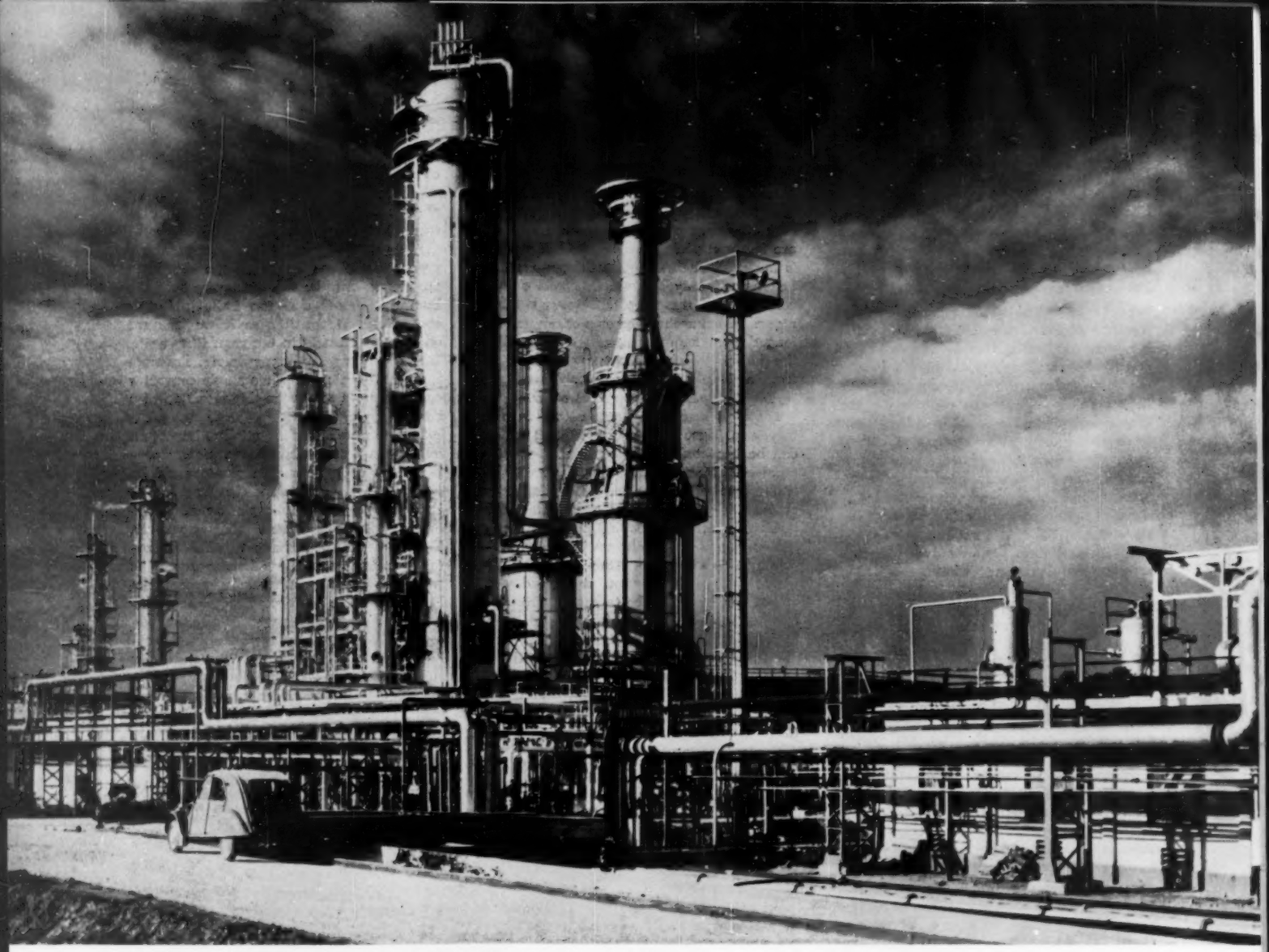


Petro-Chem iso-flow furnace at Esso Petroleum Co.'s Fawley refinery: With total duty of 140 million Btu per hour, it is largest heater of its kind in the country. Over 170 ft high. It has a shell diameter of 31 ft 6 in.



New distillation unit at British Petroleum Co.'s Lavéra refinery, near Marseilles, brings refinery's total capacity to four million tons per year. Operated by BP's French affiliate, Soc. Française des Pétroles BP, capacity of new unit is 2.2 million tons per year (BP photo).

France

by Guy Henry

Third Plan of Modernization envisages increase in French refinery capacity by building interior plants.

In the general scheme which is evolving for developing European refining, authors of the General Report of the Power Commission of the Third Plan of Modernization have concluded it is necessary to increase the refining capacity of metropolitan France to 42 million tons of crude per annum in 1961, from 30 million. On the other hand, the Commission des Carburants of the Third Plan is adhering to the following general policies relating to the development of the capacities of refining:

a. To furnish means well adapted for treatment of the newly acquired national supplies of crude oil and the location of these means, so far as possible, in relation to future discoveries in the sedimentary basins of metropolitan France.

b. To obtain maximum economy in the transport and delivery of crude oil and refined products—especially as regards transport of crude oil by tankers—and the interior distribution of crude oil and refined products by pipeline in cases where such transportation is likely to assume large proportions.

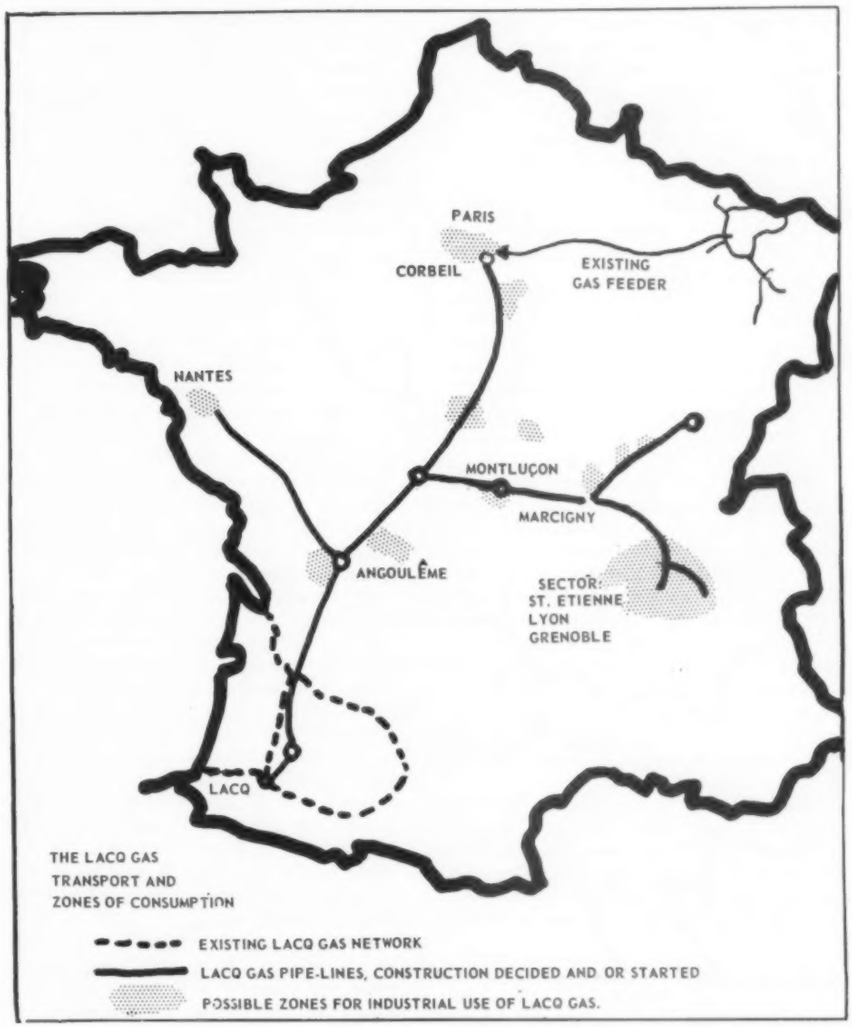
c. To adapt the production of the principal finished products in consonance with the ensemble of the French economy, rather than to try to establish this equilibrium by locating the new refineries solely with a view to transport facilities which are likely to result in onerous difficulties.

La Commission de l'Enérgie du Illime Plan goes on to say that it will be interesting to note the reaction of the refiners to the proposed European system, wherein it is proposed to locate a refinery at Strasbourg, which will be the first important French unit in the interior of France. It will be supplied by pipeline, and will have its market not only in eastern France, but also in southern Germany and in Switzerland.

The same commission also takes into consideration that this extension of petroleum consumption will require—besides port facilities and the building of tankers—the development of special means of distribution and storage facilities.

Further, pipelines for finished products for civil and military use (for example, double facilities from le Havre to Paris, or Donges to Metz, or from Lavéra toward the north along the valley of the Rhone, with eventual branches to Strasbourg and to the south of the Paris basin) must involve port facilities in the zones served by the refineries.

These were the principal suggestions offered last year to the government by the authors of the Third Plan. Out of these suggestions have arisen projects for constructing refineries in eastern France which will be linked with other projects, and will require pipelines for crude oil, extending from the Mediterranean along the valleys of the Rhine and the Ruhr to the North Sea.



There are here involved the following projects for inland refineries:

a. The project of Cie. Française des Pétroles, Cie. Française de Raffinage Antar, for a refinery near Strasbourg, for which there recently has been formed a Société de la Raffinerie de Strasbourg, the Ozo plan for a refinery which would be located in Burgundy, near Châlon sur Sâone.

b. The Shell Berre-Caltex plan for a refinery situated in the Strasbourg region.

Before describing these projects, it may be remarked that they will modify the structure and the economy of the refining industry both in France and in western Europe.

Up to the present time, the French have generally considered that the refineries should be located on the shore line, or not far away therefrom, for convenient supply of fuel for shipping; from these maritime sites the finished products would be sent to inland distribution depots, through pipelines similar to the one from le Havre to Paris—which has appeared to be a satisfactory means of transport, even though it is limited to handling light products.

From the growing need for heavy fuels in the Rhine region—where population density is the greatest in Europe, and where is to be found the greatest concentration of European heavy industry—it now appears desirable to establish large refineries which would be supplied by pipelines. Heavy fuels which have been found adaptable to numerous heavy industrial plants would thus have the same economy of transport now enjoyed only by the light refinery products.

Numerous studies have shown that an inland refinery which is supplied by pipeline with crude oil will find advantage if it it located at a sufficient distance from the maritime terminal so that the reduced cost of transportation of crude oil by pipeline, added to the cost of shipping the finished products to the centers of consumption, would have a price advantage over products shipped from a seaboard refinery.

The refinery should, therefore, be located as closely as possible to the regions which are the largest consumers of heavy fuels. The inland refinery should also be as close

as possible to the network of rivers and canals which will give easy passage to the finished products in all directions.

The dimensions of the refinery should be large, so that investment costs and operating costs may be as low as possible; at the same time, it should not be oversized in relation to consumption within the zone it can economically supply; otherwise, it may be of advantage to establish another refinery somewhere along the pipeline, or to construct lateral branch lines.

Up to now, frontiers have been walls against petroleum products, but the European Common Market should suppress tariff barriers, and should permit the eastern refineries to fan out in all directions.

Under these circumstances, the valley of the Rhine seems to be an ideal location for an inland refinery.

As regards the new refinery at Strasbourg (which has already been approved by the Commission de Modernisation des Carburants), its initial useful capacity has been fixed at five million tons at the start in 1961, which is to be extended to 8 or 10 million tons in 1965. This is a considerable enlargement over the previous idea in which it was contemplated to replace and to double the capacity of the Markwiller refinery (400,000 tons); this change of view is due to the fact that a petroleum refinery, to be economical, must start from a capacity of two million tons.

A pipeline coming from Lavéra will supply the refinery with crude oil; and its alignment already has been nearly finished. It crosses the Rhone valley and follows the Saône—and, not far away, the Rhone canal—to the Rhine. Along its course, it will be in a position to supply the eventual refinery of the Société l'Omnium Pétroles in Bourgogne. Ultimately, it will no doubt be extended towards Cologne, where two important refineries are in course of erection.

In this wise, Middle East and Saharan oil will pass from the Midi toward the northeast, and will shortcircuit the Mediterranean-Gibraltar-Rotterdam sea path now taken by oil tankers. The more grandiose project of a European pipeline sponsored by Shell—which would stretch from Lavéra to Rotterdam, with branches to Cologne, Amsterdam, and Wilhelmshaven—has not yet been accepted by all the interests. Among the opposition is the German Esso company, which has taken the position that its supply line should take its beginning on German territory, i.e., from Wilhelmshaven.

Construction of the Lavéra-Strasbourg pipeline will be undertaken by the Société Sopimer (Société du pipeline Mediterranean-Rhine) composed of 11 participants—including the Belgian Purfina, and the group of independent German refiners.

The Strasbourg refinery is destined, in effect, to serve the vast hinterland described within a circle, of which Strasbourg is the geometric key—encompassing eastern France, Switzerland, and southern Germany, where a gentleman's agreement is being drawn up with the Cologne refineries to delimit the zones of action which may even double the existing complementary exchanges of production. Switzerland will receive its petroleum supply by tank-barges coming from Rotterdam up the Rhine as far as Basle. It will be of advantage for the Swiss to be supplied from Strasbourg.

Southern Germany will be supplied from the Strasbourg base by barge-tankers which will come down the Rhine instead of having—as is now the case—to come up from Rotterdam. These oil barges will also use the Main and the Neckar.

Eastern France will be supplied by rail, but mostly by barge-tanks which will use the Rhone-Rhine and Marne-Rhine canals from which they will unload as distributing points in the Strasbourg area, where tank trucks will take over.

Returning to the Shell-Caltex project, it may be considered there is place for two refineries near Strasbourg—each with its own economical capacity, due to the increase of industries which are big fuel-oil consumers in this region. As regards the Burgundy refinery, the project has not as yet been approved. Be that as it may, it is evident the inland refineries cannot begin unless they are assured of receiving crude oil when they start operations. Outside France, collaborators in the Common Market already have two pipelines under construction: (1) The Wilhelmshaven-Cologne pipeline—the first one to start—will feed the big Ruhr refineries. The Rotterdam-Cologne pipeline will supply the Godorf refineries now under construction.

On the other hand, two projects are under study: the SOPIMER and the SAPPEUR. The SOPIMER will link with the French refineries, the Petrofina Bèlge, and a German group which previously contemplated construction of a pipeline Marseilles-Strasbourg-Cologne, but is now limiting its study to the Marseilles-Strasbourg route.

This project contemplates a 22-in. tube with eight pumping stations, with a capacity for transporting 8 to 10 million tons. It is thus a pipeline strictly limited to the possibilities offered by the Strasbourg refineries.

A large 30-in. international pipeline would require an investment only 30% greater than a 22-in. line, and would have a capacity for transporting 30 to 40 million tons. It may be added that the construction of these pipelines would require revamping French port facilities—especially for receiving, at Lavéra on the Mediterranean, the large 100,000-ton seagoing tankers.

For accommodating these large units, it will be necessary to provide basins for receiving vessels drawing up to 48 ft; there will also be needed powerful unloading equipment and storage capacity large enough to obviate any delay in unloading and to keep the pipelines in operation at full capacity, which requires storage capacities for at least 10 to 12 days. This will require a very large area for storage at the port.

The Common Market must be considered in this connection. France is confronted with the fact that on its frontier (in Germany) there are being established important refineries which, on the day when tariffs are abolished, will be in a position to pour their production into the market of eastern France. At the present time, the

Table 1

Capacity of French Refineries, January 1, 1958

Company	Location	Tons Per Year
Cie. Française de Reffinage (CFR)	Normandie	3,600,000
	Provence	5,875,000
Antar PA	Donges	1,700,000
Pechelbronn (SAEM)	Merkwiller	210,000
Cie. de Raffinage	Petit-Couronne	3,300,000
Shell-Berre	Pauillac	800,000
	Berre	3,800,000
Sté. Française des Pétroles BP (SF BP)	Dunkerque	2,200,000
	Lavéra	4,200,000
Esso-Standard SAF (Esso)	Port-Jérôme	4,250,000
Mobil Oil Française	Notre Dame de Gravenchon	850,000
	Frontignan	1,400,000
Caltex SAF	Ambès	1,300,000
	Total	28,285,000

Table 2

Output of French Refineries

Company	Refinery	1956 (Millions of Tons)	1957 (Millions of Tons)
CFR	La Mède	3,949	3,287
	Gonfreville	2,890	2,497
Antar PA	Donges	1,807	1,848
	Merkwiller	128	110
SAEM	Merkwiller	53	60
SF BP	Lavéra	2,149	1,900
	Dunkerque	1,976	1,784
Shell-Berre	Berre	2,994	3,108
	Pauillac	657	604
	Petit-Couronne	2,312	2,293
Mobil-Oil	Frontignan	975	1,046
	Gravenchon	736	679
Esso	Port-Jérôme	3,328	3,148
Caltex	Ambès	1,032	957

Table 3

1957 Domestic Consumption of Petroleum Products in France

Product	Tons	% Change from 1956
LPGas	584,134	+13.2
Aviation gasoline	182,080	+14.2
Motor fuel and supercarburants	5,367,546	— 2.9
Special gasoline	57,757	— 5.7
White spirit	50,076	+ 5.6
Kerosine	96,606	—13.3
Special carburants	101,285	+ 4
Gas oil	1,434,824	— 8.1
Fuel oils	9,252,001	+ 0.6
Lubricants	481,393	— 1.1
Paraffins and waxes	16,428	—12.8
Bitumen	977,654	+ 3.9
Total for the domestic market	17,601,784	— 0.4
Marine fuel:		
For French ships	1,125,185	—16.3
For foreign ships	562,351	—16.6
TOTAL	19,289,320	

Table 4

1958 Estimated Total Demand for Products of French Refineries

	Tons
Butane and propane	755,000
Dry gas	200,000
Aviation gasoline	300,000
Carburants	453,000
Kerosine and white spirit	390,000
Heavy gasoline	70,000
Special gasoline	120,000
Motor fuel	5,575,000
Gas oil	6,492,000
Heavy fuel	8,760,000
Lubricants	595,000
Bitumen	1,200,000
Paraffins and waxes	25,000
Various products, including petrochemicals	240,000
Total	24,850,000

French refining industry is subject to a fiscal regime which, on top of the cost of the industry's equipment and the costs of its operations, imposes a tax of 24.2%; whereas producers in the neighboring territory pay a tax between 4% to 8%. It is for this reason that the government of France has striven "to modify the fiscal and tariff regime of petroleum products so as to place producers and distributors on a common legal basis as regards their investments and their costs of fabrication."

It is essentially a matter of placing the French industry under the "rule of taxes on added value" which will permit the industry to meet, under the best conditions, the advent of the Common Market. This is very important because, once the Common Market is functioning and national importations are suppressed, there will be in existence an essential base for establishment of a new refining industry which will be economically operative—which means it will be able to pay its costs. It will then be appropriate that the handicap which has afflicted our industry be eliminated.

At the end of 1957, the capacity of French refineries totaled 28,285,000 tons per year, as indicated in Table 1. Throughput during the year totaled 24,965,000 tons, obtained from the following sources: Kuwait, 7.7 million tons; Iraq, 3.4; Qatar 2.5; Saudi Arabia, 2.4; Iran, 1.7 (total Middle East, 18.6 million tons, or 74.69% of the total). Other sources, in millions of tons, were: USA and Canada, 1.8; Latin America, 2.8; USSR, 0.2; Indonesia, 0.003; and French fields, including overseas territories, 1.5.

Output of finished products totaled 23,321,000 tons, compared with 26,810,000 tons in 1956. Detailed output by plants is given in Table 2. Domestic consumption of various products, with percentage change from 1956, is shown in Table 3. The decrease in motor-fuel consumption was only partly due to the Suez incident. Heavy taxes and high product prices forced motorists to reduce their budgets.

Fuel-oil consumption did not rise as had been anticipated because of disturbances in supply and because of warm weather early in the year. Industrial consumption also was adversely affected by conversion to natural gas from the Lacq region. Domestic fuel quality has been improving in France, and this has increased consumption.

Estimated national consumption this year is quite similar in volume to 1957. Details by products are shown in Table 4.

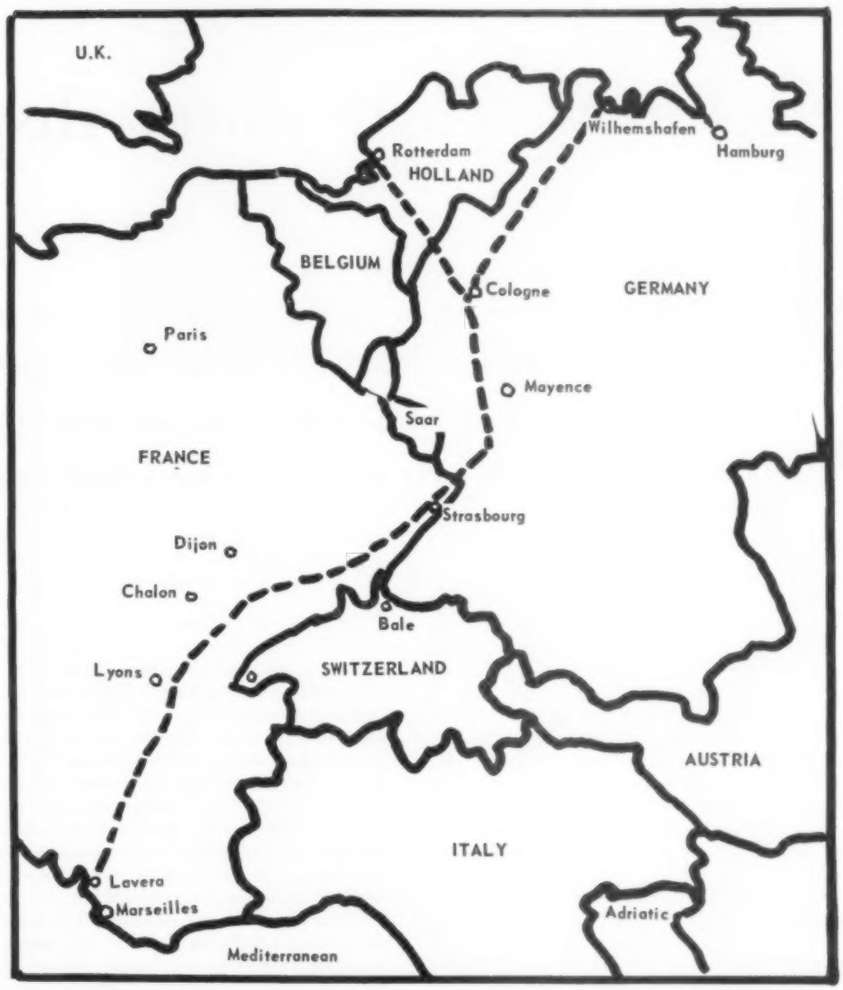
Expansion of the petrochemical industry in France at the moment centers on the conversion of natural gas from the Lacq field. Aside from the production of sulfur, there are the following prospects:

1. Use of natural gas from this source for production of synthetic ammonia in southwest and southeast France.

2. A new company, Société des Produits Chimiques d' Aquitaine, which will fabricate acetylene, ammonia, and methanol; the ammonia will serve in the preparation of nitrogenous fertilizers and eventually of ammonium sulfate and also the urea-formaldehyde resins and acetaldehyde *via* acetylene.

3. Lacq in 1962, is expected to supply 140,000 tons per year of propane and butane and 240,000 tons of every aromatic gasoline.

4. The Lacq formation may also supply heavy water; one company has a pilot plant working on the project.



The question of Lacq gas is of extreme importance to France, which justifies its inclusion in this study. The main object of the French petrochemical industry is to liberate the country from the burden of imports which have to be paid in foreign exchange. The incentive is great enough to encourage continued building. END

Table 5

Petrochemical Plants in France

Company	Location	Raw Materials	Products Fabricated	Destination
Atlantique Progil Electrochimie	Donges	Propylene (P) Benzene (C)	Cumene	Phenol & acetone
Progil Electrochimie	Pont de Claix	Cumene	Phenol & acetone	Solvents, chlorinated phenols, synthetic tannins, phenoplastic resins
Rhône-Poulenc	Péage de Roussillon	Propylene (P) Benzene (C)	Phenol & acetone	Solvents Nylon
Shell St. Gobain	Grand-Couronne	C_5 plus kerosine	Alkyl sulfate of soda	Detergents (Teepol)
Shell St. Gobain	Berre	Propylene (P)	Isopropanol and acetone	Solvents
Marles-Kuhlmann	Chocques	Propylene (P)	Propylene oxide and derivatives	Polyester resins
Esso-Standard	Port-Jérôme	Propylene (P)	Tetrapropylene	Dodecylbenzene for synthetic detergents
Standard-Kuhlmann	L'Estaque	Benzene (C) Tetrapropylene	Dodecylbenzene	Detergents
SIDA	La Chambre	Isopropanol (P)	Diacetone alcohol, methyl isobutylketone, methyl ethylketone	Solvents
Naphtachimie	Lavéra	Heavy gasoline or kerosine (P)	Ethylene oxide, isopropanol, and acetone	Antigel, solvents, polyester resins

P—from petroleum. C—from coal.

Refinery waste-water disposal

At a cost of $363,000, Continental Oil Co. has developed an effluent water-treating system for its Ponca City refinery which involves the installation of holding ponds, a bio-oxidation plant, steam-stripper unit, and consolidation of all water effluent into one outfall stream.

by C. D. Hull

C. D. HULL is manager of the Ponca City, Okla., refinery of Continental Oil Co. A native of Berryville, Ark., he attended State Normal College at Springfield, Mo., and joined Continental in 1920 as a pumper helper at the Ponca City refinery. Through successive promotions at this refinery, he became assistant to the refinery superintendent in 1928 and assistant to the manufacturing manager the same year. Promoted to superintendent in 1949, he was named refinery manager in 1952.

SUPPLY and quality control of water were forcibly brought into focus during the past few years, particularly 1956, when the lack of rainfall throughout Oklahoma caused great damage to fish life and inadequate supplies of water for industrial and human consumption. Conservation of surface and subsurface water and the maintenance of high quality are matters which are of vital importance in our state and nation, and to us as individuals.

The maintenance of good, clean, recreational facilities in the form of high-purity water in lakes and streams should be of interest to everyone since more leisure time now available has resulted in a great increase in the number of people who participate in such outdoor activities as water skiing, boating, fishing, and hunting. All of these forms of recreation require an ever-present supply of unpolluted water, and ample supplies of high-purity water in our streams and lakes are of utmost importance in drawing tourists and new industries to our state. Such attraction means new customers for products and greater income to industry and the state.

The amount of water required for industries varies quite widely, but the magnitude of the demand may be brought into sharper focus if we realize that a refinery the size of Continental's in Ponca City will use four to five million gallons of fresh makeup water a day—enough to supply a city of 15,000 to 20,000 population.

Waste-water disposal, and the effect of refinery effluent on natural water, has long been recognized in the refining industry through its official organ, The American Petroleum Institute. In 1929, the Institute accepted the responsibility in the field of pollution abatement and established a committee to determine the proper methods of disposing of refinery wastes. Objectives of the committee were:

> "To collect, summarize, and recommend for publication to the industry information which will direct and promote good practices in the design, construction, and operation of waste-disposal equipment to the end that the refineries of the petroleum industry in America do not release wastes of any kind which may interfere with the interests of their neighbors or the public in general."

The Institute is continuing active studies in water effluent matters, and many representatives from the refining industry are serving on the committee.

The first water contaminant from petroleum refining of general concern to the public was in the form of oil which was readily recognized and could be seen by visual inspection. Refiners initially solved this problem with a wide variety of sumps, ponds, and separators of various sizes, shapes, and design in an attempt to remove oil from the affluent stream; and the recovery of oil was another means of oil conservation in which the refiners were particularly interested. Oil separation from the water was one of the first studies undertaken by the API committee; and, after several years of experimentation at Atlantic Refining Co.'s Philadelphia refinery a separator utilizing gravity separation with a rather high degree of efficiency was developed. Improvements have been perfected through the years, as evidenced by the March 1953 fifth edition, Vol. I, of the API manual entitled *Waste Water Containing Oil*. The first edition on this subject was published in 1930.

For many years, the effluent stream in the Ponca City refinery was divided with part of the water flowing to the Arkansas River and part to the Salt Fork River. A few years ago this was changed, and now all effluent water from the plant flows to the Salt Fork with no outlet to the Arkansas.

Bio-oxidation plant showing inlet cell in foreground, oxidation cell in center, and holding pond in background.

Cost of this change was about $93,000.

The plant is divided into four main sections, viz.: light oil, lubricating oil, thermal, and catalytic cracking divisions. In each division, the effluent-water stream flows through an oil-water separator with API-designed features before entering the common outfall stream. We have a series of water-spray ponds within the confines of the refinery which are equipped with oil separation and skimming devices for recovery of any oil which enters the ponds through the spray system. Overflow from these ponds and the water from the four division separators join in a common outfall stream, which then passes through final holding ponds constructed in 1954 with designed features exceeding those of the API specifications. The holding ponds are composed of two large parallel rectangular basins having a capacity of 6.8 million gallons, or equivalent to three days' holding time. Cost of the ponds was approximately $150,000.

There are a number of reasons for building the holding ponds as outlined later; but, principally, they are for the purpose of recovering any oil which could not be reclaimed in the division separators or oil traps; and, in addition, they provide holding time which permits settling of solids contained in the water stream. Velocity of water through the holding ponds is materially reduced, and most of the suspended solids settle in he forebays. Accumulation of solids in the forebays is removed by diverting the water stream into one reservoir while the other is idle. Cleaning of solids from the idle forebay is done about once each week by agitation of the water and solids, then pumping of the solution to nearby settling ponds where the water drains back to the reservoirs. Some suspended solids with the water flow from the forebays to the main sections of the holding ponds, cleaning of which is necessary about every two years. Removal of solid matter from the ponds greatly improves the appearance and quality of the final effluent.

An important function of holding ponds or reservoirs is the residence time which levels out the quality of water by reducing the harmful effects of pollutants brought about by temporary operating upsets or spills. Aeration and oxidation also take place, and the ponds become effective biological treating plants—the same as provided in natural ponds and streams.

We anticipate effluent from the biological oxidation plant, discussed later, to furnish sufficient bacteria in the overflow for sending the stream to and including the holding ponds—which will reduce the small quantities of phenols and sulfides which may come from other sources in the plant.

There are other means of oil recovery from water streams such as the process known as air flotation. In this instance, a portion of the water is saturated with air under 40-lb pressure. The release of the pressurized water through special discharge nozzles into the main body of effluent water will cause release of numerous small air bubbles which rise to the surface carrying suspended matter and oil in the form of a froth which is removed by a continuous, traveling scraper.

Early water-contaminant problems included acidity from the use of sulfuric acid and alkalinity from the use of caustic and lime. The acid problem is largely now nonexistent, since the discontinuance of treating lubricating oil with sulfuric acid and the present use of solvents for this purpose.

When acid was originally used, the sludge was generally stored in earthen pits then used as plant fuel in a rotary-type sludge burner. In our more modern lube-oil treating processes, solvents are reclaimed and reused, and do not constitute a disposal problem except for the eternal vigilance against leaks and spills. Other acids used in a refinery, such as muriatic (a component part of inhibitors for equipment cleaning) may, within reasonable limits, be included in the refinery effluent to help neutralize the normally alkaline stream.

Caustic—principally used in the treatment of gasoline—is a difficult problem to many refiners. Most of the spent caustic material is rich in recoverable acid oils such as cresols and phenols, and at Ponca City the product is segregated and loaded into tank cars and sold to a chemical company for reclamation. Other strong caustic solutions are placed in earthen pits. Certain weak caustic solutions and other alkaline water, such as boiler-water treating solutions and boiler blowdown, are neutralized, if necessary, in the holding ponds.

Pilot-plant studies have been made using sulfuric acid to maintain a pH value at or below 8.2 in the east bay of the existing holding pond, while the west bay was used for comparison without pH control. Our information indicates that effluent water having a high alkalinity usually has a toxic effect on fish life.

Neutralization of alkaline water also can be accomplished by bubbling flue gas rich in carbon dioxide through the water in a packed tower. Further study of the need for neutralization will be made before installation of such equipment in our plant.

In recent years, other new chemicals have been brought into use, or are produced in the operations, which are of greater concern than oil which may be in the effluent-water stream. Refiners have been active in the study of chemical con-

Final sludge cell for recycling to oxidation section.

taminants; and, in addition, the Institute has done a great deal of work on this phase. It published an API manual entitled *Chemical Wastes* in 1935, and issued a second edition in 1951.

Certain chemicals which concentrate in the water phase primarily from cracking operations, which include sulfides and phenols, are very harmful contaminants because of their oxygen-consuming properties. Water with a high chemical oxygen demand (COD) will not support fish life. To remove the sulfide from the principal sour-water streams, a steam-stripper tower was installed in 1954 at a cost of $45,000. The unit is designed to operate on 100 gal per min of feed, and it is effective in removing in excess of 90% of sulfides contained in the feed water. Effectiveness of the steam-stripper operation may be observed by these tests:

	Feed Water In	*Effluent Water Out*	*% Removal*
Sulfides, ppm	8,960	154	98
Phenols, ppm	866	682	21

Phenol is highly soluble in water, and above certain limits is toxic to fish and a source of maltaste and odor in water. It is generally agreed that phenol concentration must be low, particularly if the water is used downstream for municipal supply or other potable uses. In some cases, a maximum limit of three parts per billion is stipulated for the receiving stream. Phenol is not harmful above this concentration; but, when the water is chlorinated for drinking purposes, a taste and odor problem then exists. At our plant, phenols are principally concentrated in the sour-water stream to the steam stripper previously referred to; however, this type of operation removes only part of the phenols, although it is quite effective in the removal of sulfides. This leaves the problem of finding a means of treating the phenol-bearing water from the stripper tower. We recently resolved this problem by construction of a biological oxidation plant at a cost of $75,000, primarily for the removal or consumption of phenols contained in the effluent from the sour-water stripping unit. Certain bacteria have been developed which will thrive in a water containing phenol; and, when provided with required nutriments, such as phosphates and magnesium salts, will consume the carbon and nitrogen found in phenol, ammonia, and other contaminants such as sulfides.

There are two general types of biological oxidation systems now in use in the refining industry. One is the trickling filter; the other is the activated sludge system. The latter process was selected for the Ponca City refinery because of its greater aeration efficiency or greater oxidation capacity for a given volume. Oxidation rates are highly dependent upon temperature—the rate being about seven times greater at 95 F than at 60 F. Provision has ben made for adding heat to the biological oxidation ponds by means of open steam to maintain optimum operating temperature of about 95 F. The accompanying photographs give some idea of the general construction features of the biological oxidation plant. The plant has been in operation only a short time, but results thus far are quite gratifying as indicated by laboratory tests:

	Feed Water In	*Effluent Water Out*	*% Removal*
Sulfides, ppm	221	2	99
Phenols, ppm	737	37	95
Ammonia, ppm	2,363	884	63
pH	9.4	8.4	—

The biological waste-treating process is fairly new to the petroleum industry, and bacteriologists have high hopes of finding a combination of operating conditions and a mixed population of microorganisms which will eventually attack all contaminants. In effect, the biological oxidation plant compresses the natural water purifactions which occur in several miles of open stream to the area of a treating plant on the refinery site.

There are four miles of open ditch through which waste water flows from our holding ponds to the Salt Fork River. Analytical tests show material improvement in the quality of water as a result of the natural flow of water from the ponds to the river due to aeration and bacterial action in a flowing stream.

One of the most reliable tests involving the quality of effluent water is obtained through bio-assay tests to determine the toxicity of the water to fish. We currently make bi-weekly tests in our laboratory on the effluent stream as it leaves the holding ponds and as it enters the Salt Fork River to determine toxicity of the water to aquatic life.

About two years ago, 10 oil companies with 13 refineries in Oklahoma and one in Kansas formed an organization known as "The Oklahoma Refinery Waste Control Council." There were 11 stated objectives of this organization—the main one being to pool their know-how and experience in helping one another solve the problem of pollution abatement relative to refinery effluent water. The group meet once each quarter for the discussion of mutual problems of waste-water disposal.

Oklahoma State University is actively interested in this organization, and has promoted a research program which is sponsored by the participating refiners. The research project is still in its first year—which includes the construction of a trailer laboratory fully equipped for bio-assay testing. The principal purpose of the research program is to make toxicity studies with fish at each refinery location and to determine the amount of dilution or treatment which is necessary to permit survival of fish during continuous exposure. The ability to live in refinery streams varies with different species of fish and fish-food organisms, and the study of these variations is to be further considered by the Oklahoma Refiners' Council as its work progresses. Total contributions to this project by Oklahoma refiners for the first year's operation amounted to approximately $13,000 with future increase possible.

At most of the Oklahoma Refiners' Council meetings, there has been at least one state official present who is primarily responsible for the handling of legislation and penalties for stream pollution. This affords the state and refiners an opportunity to review the problem from both sides in an attempt to reach controlled limits which are realistic.

Another treatment of water being studied in a pilot plant at Ponca City is one of nature's remedies—that of lagooning. Purpose of the experiment is to determine the optimum surface-to-volume ratio in a series of 10 lagoons in cascade—each having a 1-day holding time.

Using a series of 55-gal drums cut in half and laid lengthwise and another series of whole drums standing upright, we have examined two extremes of shallow and deep ponds. Some test results show:

	Shallow Lagoons (Half Drums)		*Deep Lagoons (Whole Drums)*	
	Water In	*Water Out*	*Water In*	*Water Out*
Immediate oxygen demand —ppm	5.2	0.0	6.0	0.0
Chemical oxygen demand —ppm	250	175	275	187
Dissolved oxygen —ppm	0.0	5.5	0.0	2.0
pH	8.3	7.2	8.4	7.4

From the above and other tests, shallow lagoons with correspondingly large surface exposure appear to provide a more rapid rate of oxidation for residual chemical wastes. The pilot units possibly are not adequate to show the relative bacterial action in the two systems. Total holding time of water is certainly to be considered in determining the size and number of such lagoons which might be necessary for maximum benefits obtainable in additional settling time. An ideal objective would be a series of lagoons in which fish life could always be maintained—at least in the last lagoon. Such lagoons should not be regarded as replacement for other treating facilities. Their function should be primarily for final oxygen buildup to provide for bio-oxidation of slowly oxidizable trace wastes and as insurance against surges due to accidental spills and mechanical failures.

An important step in the control and proper handling of refinery effluent water is to determine as nearly as possible the chemical composition and the volume from each individual location in the plant. Sometime ago, a survey was made of each water source in the refinery, in the development and research department, and in the general office building; and each stream was measured, sampled, and tested for contaminants. All personnel have been carefully instructed as to the importance of water-pollution abatement and the necessity of segregating harmful wastes for special handling to avoid contamination of effluent water. This is not exactly water

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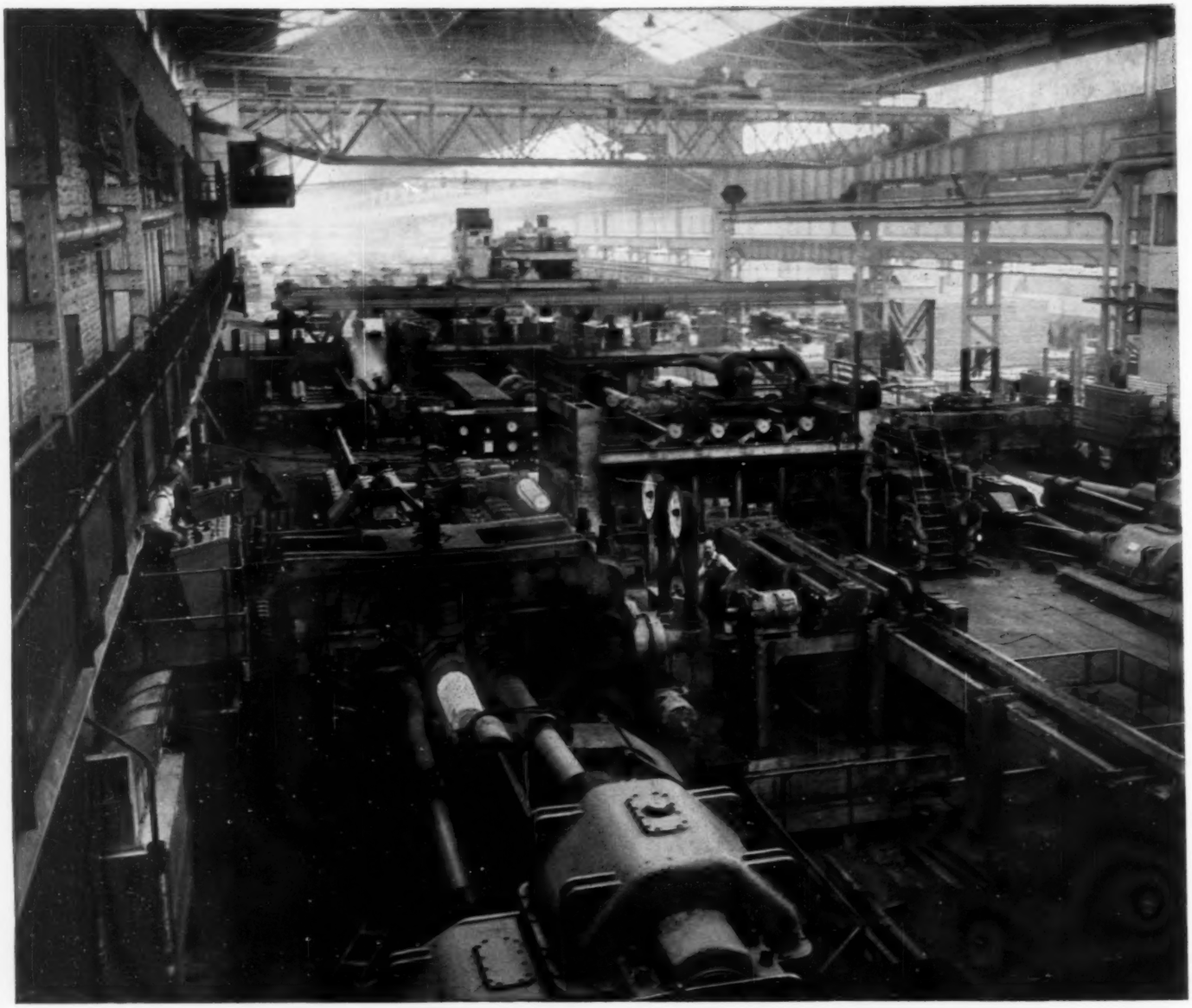

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Oxidation cell of bio-oxidation plant.

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treating, but it is a very necessary step in the overall control of water pollution.

Disposal of harmful wastes in earthen pits to avoid contamination is an important phase of the waste-disposal problem. Various individuals in the refinery make frequent visual inspection of the oil traps, holding ponds, and effluent streams. Samples of effluent-water streams are obtained in each division every four hours, and are sent to the laboratory for inspection; and a daily composite sample of each stream is made in the laboratory from the four-hour samples and retained for a period of one week for analytical testing. Frequent samples are taken and tested in our laboratory of the water effluent from the holding pond, from the stream flow to the Salt Fork River, and from the Salt Fork River itself.

It might be advisable to look briefly at other chemicals used in or resulting from refinery operations which might be objectionable in the effluent water. Tetraethyl lead, used in gasoline blending and a harmful substance in the water, is completely eliminated from the effluent water in the Ponca City plant by a planned procedure to eliminate loss of products through spills or leakage and by careful disposal of tank bottoms which might contain lead.

Chlorides—chiefly in the form of sodium chloride (or common salt), sometimes a major item in crude-oil producing fields because of the salt-water disposal problem—do not cause concern in our refinery. Salt content of the refinery effluent is considerably lower than the salt contained in the Salt Fork River into which the stream flows.

Subsurface injection of refinery effluent water has been considered, but given little attention. We are of the opinion that disposal into oil-producing sands or other sands would present a treating and handling problem of considerable magnitude; however, a detailed study and cost estimate of such method has not been made.

To summarize some of the more important aspects of waste-water disposal:

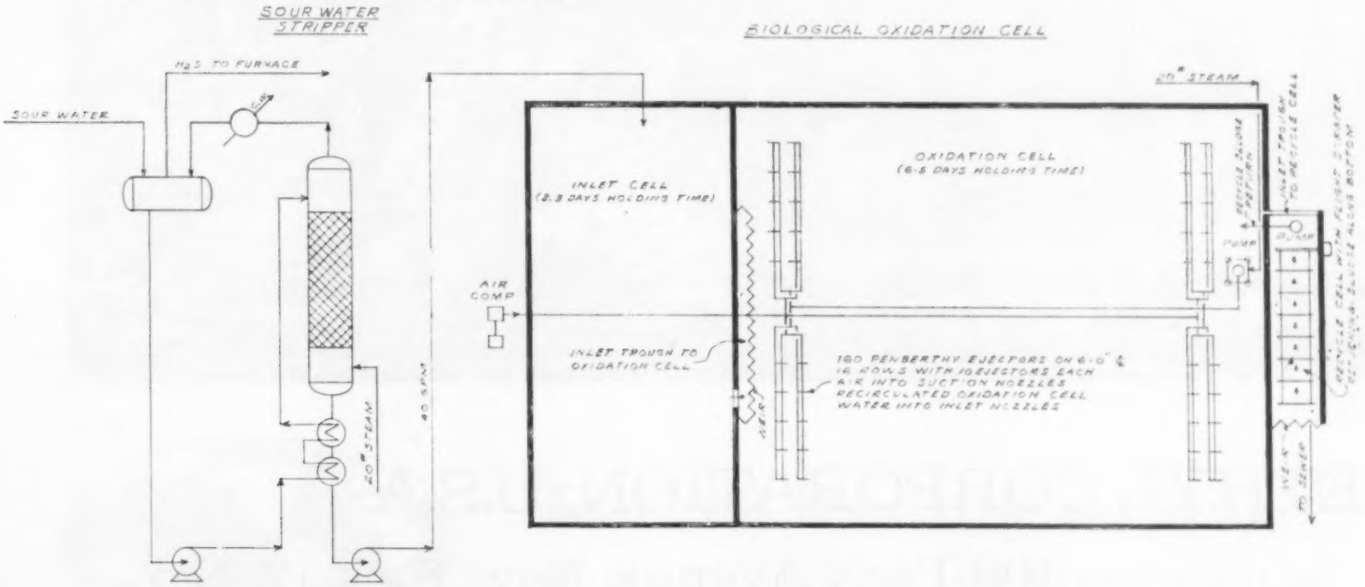
1. The oil industry—including producing fields, refineries, and marketing—has long been active in research work and installation of facilities to improve the quality of effluent water from plant operations.

2. Careful testing of each effluent water stream over long periods to determine minimum and maximum flow rates and compositions is very necessary in a refinery to determine the most effective scheme of treatment which is economically feasible. This, likewise, appears desirable for any type of industry.

3. Supervisors and employees of a refinery, or any type plant, should be constantly vigilant to observe and eliminate the source of water contaminants which are harmful to animal, fish, and human life and to further industrial use.

4. We fully recognize our responsibility in pollution abatement; and, in spite of continued increase in plant capacity, changes in processing units, and developments in the use of new chemicals, we have kept abreast of the times to the end that the purity of our water effluent has been maintained at a satisfactory level over the past several years. We can point with considerable pride to specific plant improvements in the form of holding ponds, steam-stripper unit, consolidation of water effluent into one outfall stream, and the bio-oxidation plant—all designed as conservation steps to improve the quality and quantity of refinery effluent water at a cost of $363,000. END

Flow diagram of sour-water stripper unit and bio-oxidation plant.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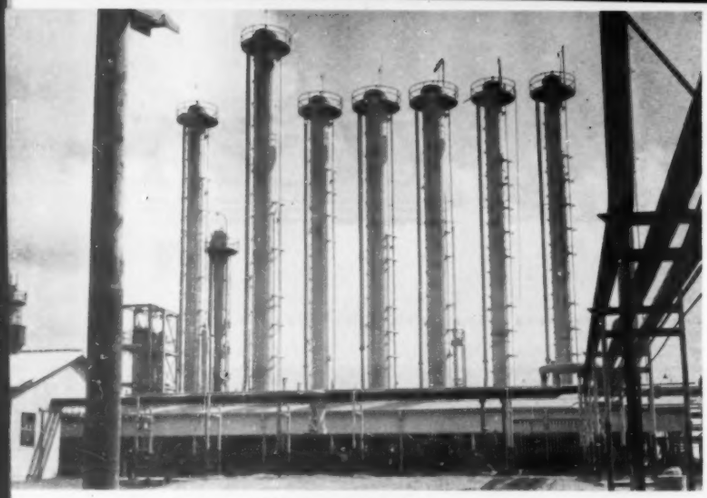
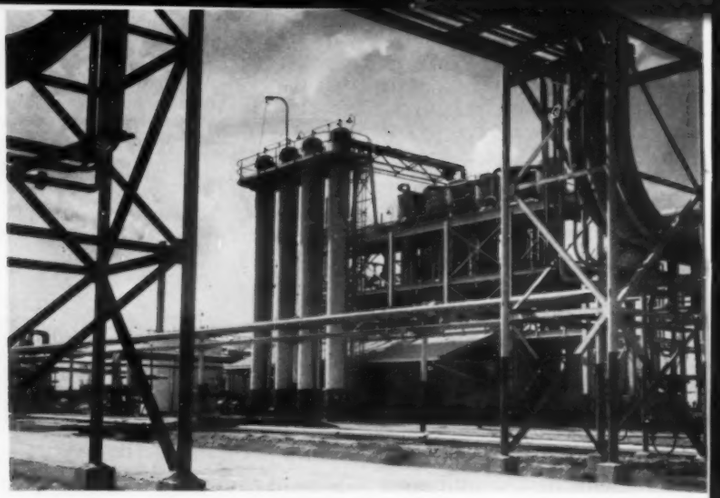


A section of the isopropyl alcohol unit at Shell Chemical Corp.'s Houston, Texas, plant (Shell Chemical Corp. photo).



Isopropyl alcohol distilling columns at Shell Chemical Corp.'s Houston, Texas, pant (Shell Chemical Corp. photo).

Petrochemical horizons for propylene

Part I: Economic trends for propylene Production of isopropanol-acetone

by Peter W. Sherwood*

PROPYLENE exhibits some of the most promising growth aspects among petrochemical raw materials. With only two exceptions (isopropanol-acetone and propylene oxide-glycol), all of its present major chemical uses were introduced commercially during the past decade, and nearly all of them continue to show a good growth rate. In addition, the recent development of propylene polymers of high molecular weight adds significantly to the future expansion outlook for propylene.

This sudden upsurge in outlets has pushed chemical consumption of propylene to an estimated 1.7 billion pounds in 1956, about twice the yearly requirements in the period 1945 to 1949. The main consumer (acetone) has been somewhat laggard in recent years, and the important push for propylene has been due to newcomers, chiefly dodecyl benzene sulfonate (detergents) and oxo-alcohols.

The bulk (about 70% in 1956) of propylene requirements is obtained directly from refinery gases or, more specifically, from cracking operations. Thus, a typical thermal cracking tail gas might contain 10% to 12% propylene, while a moving-bed catalytic cracker gas might contain 6% to 8% of this olefin. Obviously, there are wide variances in off-gas composition—depending on feed stock, refining scheme, and processing severity.

*Chemical Engineer, White Plains, N.Y.

Another propylene source of growing importance is the production of ethylene from C_3 or higher hydrocarbon feed stocks. Requirements for ethylene have grown to 3.6 billion pounds in 1957 from 500 million pounds in 1945. The outlook for future expansion for this olefin continues undimmed, and a recent forecast predicts consumption of 5.1 billion pounds in 1960, 6.5 billion pounds by 1965.

To meet these rapidly expanding requirements, ethylene production by cracking—as distinct from recovery from refinery gases—has assumed a role of growing importance. Greene[1] predicts that, of 1960's ethylene supply, one-half will be produced from LPGases while 43% will be obtained from refinery gases (both ethane and ethylene). The remainder will be based on cracking of heavier hydrocarbons and on miscellaneous minor sources.

This heavy reliance on the propane-butane fraction (LPGases) and, to a lesser extent, on heavier oil stocks, has significant impact on the propylene supply situation. In cracking these feed materials, propylene is unavoidably produced. The ratio in which propylene and ethylene is formed in single-pass operation depends on the severity of process conditions; and these, in turn, are governed by the relative need for these two olefins. Typical yield from propane cracking, where propylene is a desired product, is about 30% by weight of ethylene and 20% of propylene.

The ultimate yield of propylene is affected not only by the cracking conditions, but also by the extent of propylene recycle. The extreme case occurs when ethylene is th only lower olefin which can be profitably utilized. In such instances, propylene may be recycled to extinction—bringing its ultimate yield to zero, while the yield of ethylene may be boosted to 45% to 50% by weight of propane feed.

Such complete uselessness of propylene is, however, becoming rare; and complete recycle of this olefin is rarely practiced—principally because of the economic factors involved—but also because the presence of large amounts of propylene in feed stock to an ethylene cracker creates a serious, though not insuperable, technical problem.

Indeed, even where propylene has no chemical consumer, it still has value for alkylation and polymerization purposes. Alkylation is, of course, once again on the upswing, and can be employed to the extent that isobutane supply is adequate to react with the available C_3 to C_5 olefins. Polymerization (or, more correctly, dimerization) is used principally as a balancing operation for the olefins.

It is the usefulness of propylene as feed stock to alkylation and dimerization which sets a lower limit to its value. Petrochemical operations compete with refinery needs to this extent, and it is for this reason that

cracking of propylene to ethylene is today rarely justifiable.

A different picture exists where propylene can be converted to marketable chemical derivatives other than ethylene. In such instances, sufficient upgrading results that the value assignable to propylene exceeds the minimum set by alkylation and polymerization to refinery products.

The range of petrochemical operations and products in which propylene can serve as feed stock is indeed large, and still growing. The most important commercial conversions involved are shown schemetically in Fig. 1. It will be noted that two different routes can be employed in the conversion of propylene to glycerin. Both of these are newcomers; the allyl-chloride method made its commercial debut in 1949; production of intermediates for the acrolein route was taken onstream toward the end of 1957.

No fewer than four commercially significant syntheses of acetone employ propylene as feed stock. Three of these—in which acetone is obtained as byproduct—are new: the isopropanol-hydrogen peroxide route (1957), the acrolein-allyl alcohol route (1957), and the cumene-phenol method of synthesis (1953). The fourth method—in which propylene is hydrated to isopropyl alcohol and the product dehydrogenated to acetone—on the other hand, has served since 1923, and is today still the largest chemical consumer of propylene.

Other chemical derivatives constitute a significant, though much smaller, outlet for propylene. Table 1 shows the estimated distribution pattern which prevailed in 1956.

TABLE 1. CHEMICAL CONSUMPTION OF PROPYLENE IN 1956

Derivative	*Propylene Consumption (Millions of Pounds)*	*%*
Isopropanol	1,000	57.8
Cumene	65	3.8
Nonene	110	6.4
Dodecene	400	23.1
Glycerin	65	3.7
Propylene oxide and glycol	65	3.7
Other	25	1.5
Total	1,730	100.0

Since 1956, four more chemical consumers of propylene have entered the picture. Three of these are tied into Shell Chemical Co.'s planned new method of glycerin synthesis, viz., the production of acrolein, hydrogen peroxide (plus acetone), and allyl alcohol (plus acetone). Taking account of propylene requirements for these intermediates, production of 100 lb glycerin by Shell's new route may be expected to consume some 250 lb propylene. Planned glycerin plant capacity at Norco is estimated at 60 million pounds per year, corresponding to an annual propylene demand of 150 million pounds per year. As already indicated, acetone is formed as co-product in this process.

The fourth newcomer among propylene consumers is isotactic polypropylene. Production of this material made its USA debut in December 1957 at Hercules' Parlin, N.J., plant, which is rated at 20 million pounds per year—consuming an approximately like amount of propylene. The only two other commercial-scale polypropylene plants now in production are operated by Montecatini, at Ferrara, Italy; and by Farbwerke Hoechst, near Frankfurt, Germany. However, the prospects for this plastic are so promising that at least six USA companies are known to be operating polypropylene pilot plants at this time.

Just how much polypropylene will contribute to propylene consumption remains to be seen. Certainly, the outlook is highly favorable, and some forecasts look to USA production of 200 million pounds by 1961 and 1962.

Actually, insufficient basis is at hand for sound forecasting of polypropylene growth. This plastic is still too new to permit a quantitative evaluation. However, its properties (which we shall discuss briefly in a subsequent part) are unique and outstanding in many ways; and the product is, potentially, a low-cost polymer.

Polypropylene's outlook invites comparison to the growth history of polyethylene. Both of these materials are based on inexpensive monomers, and polypropylene is formed by the same techniques which are employed in the now commercial low-pressure polymerization of ethylene.

Polyethylene production, of course, has grown to 565 million pounds in 1956 from 100 million pounds in 1952. While nearly all of today's output is of the high-pressure type, current new production entries are principally in the low-pressure field. The outlook is for 1.3 billion pounds polyethylene production by 1960. Of this total, about one-third is predicted to be low-pressure polyethylene.

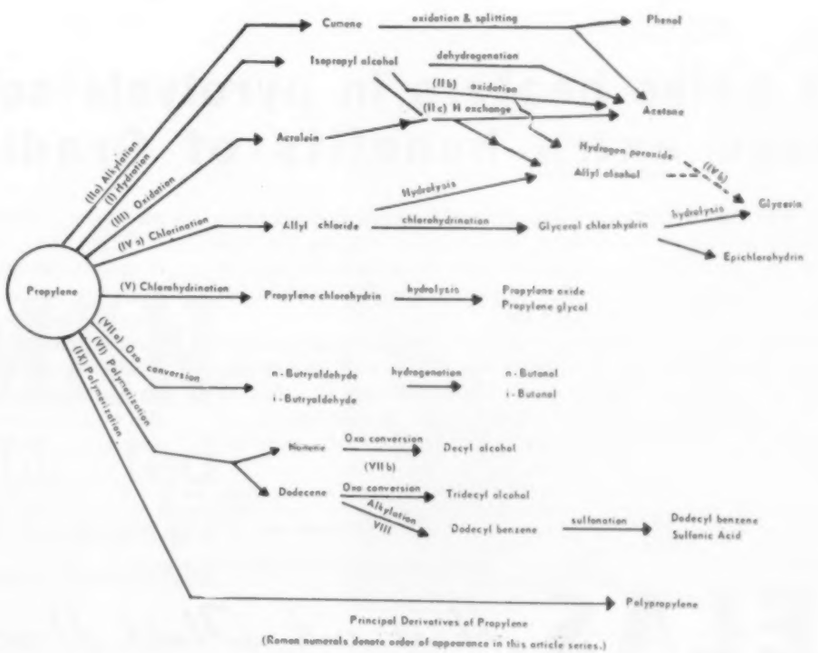
This tremendous growth history of polyethylene provides an experience basis for the optimism now shown for polypropylene's outlook. Indeed, it must be borne in mind that isotactic polypropylene is even more versatile than polyethylene, and that its suitability extends to use in fibers as well as in plastics.

From the foregoing discussion, we may see that chemical outlets for propylene are now in a strong growth stage, due largely to entirely new methods in which this olefin may be utilized. But beyond that, the field of propylene chemistry is highly active in new technical developments and in market development which affect propylene's derivatives. These aspects will be discussed in some detail in the remainder of this article and its subsequent parts.

A. Isopropanol-Acetone: Hydration to isopropanol, followed by the alcohol's dehydrogenation to acetone, is the oldest and still the largest consumer of propylene. It is also the only significant source of isopropanol and the most important route to acetone. In 1956, an estimated 1.0 billion pounds propylene was converted to isopropanol, and 82% of all acetone production in the USA was obtained by the dehydrogenation of this alcohol.

Acetone overshadows all other outlets for isopropanol; it accounts for about 57% of the alcohol's total consumption. But there are other significant markets for isopropyl alcohol—which is an important solvent in its own right, and serves as intermediate in the synthesis of isopropyl acetate, xanthates, and other minor derivatives. The distribution pattern shown in Table 2 is estimated to apply to consumption of isopropanol.

(Continued on page 96)



Principal Derivatives of Propylene

(Roman numerals denote order of appearance in this article series.)

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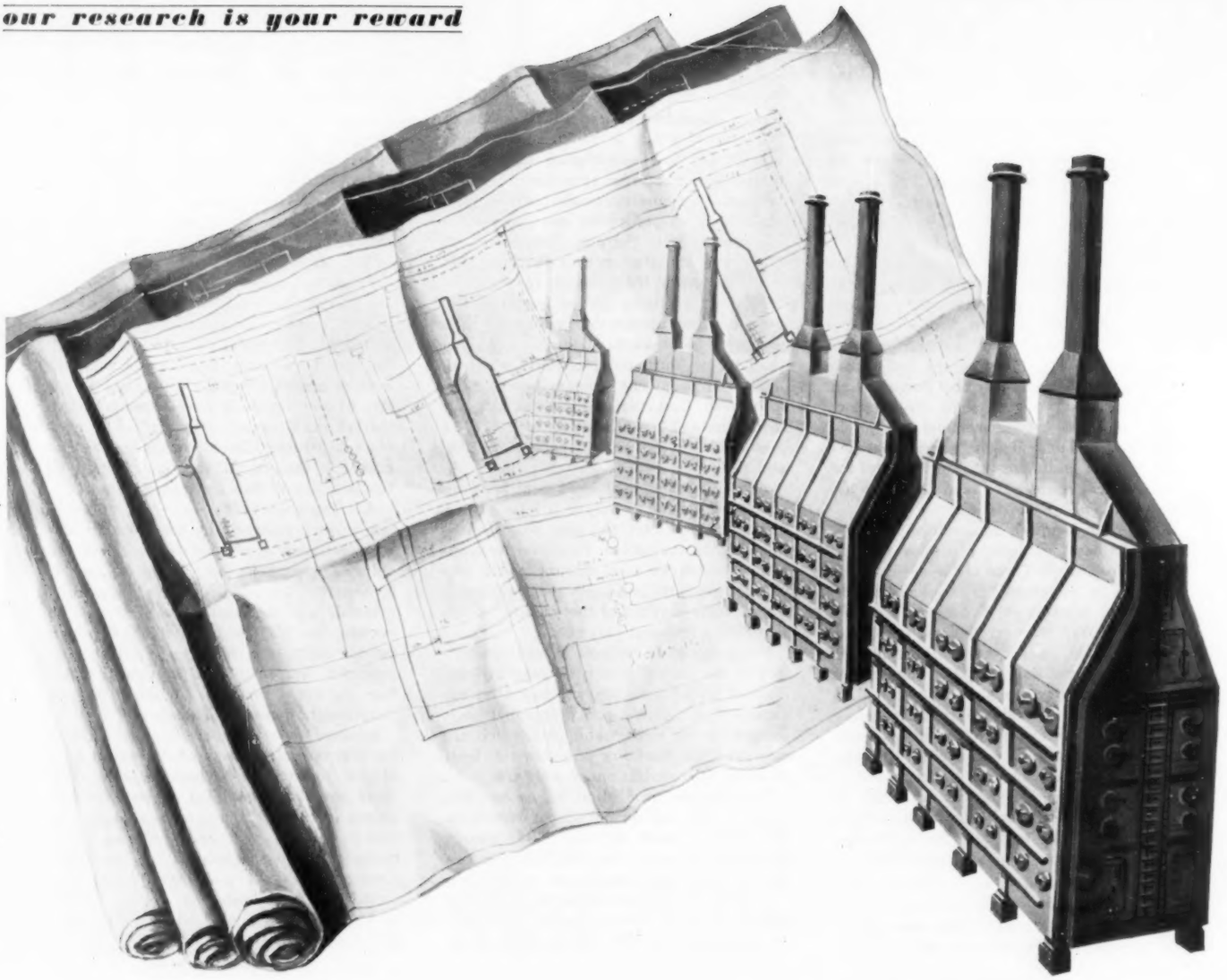

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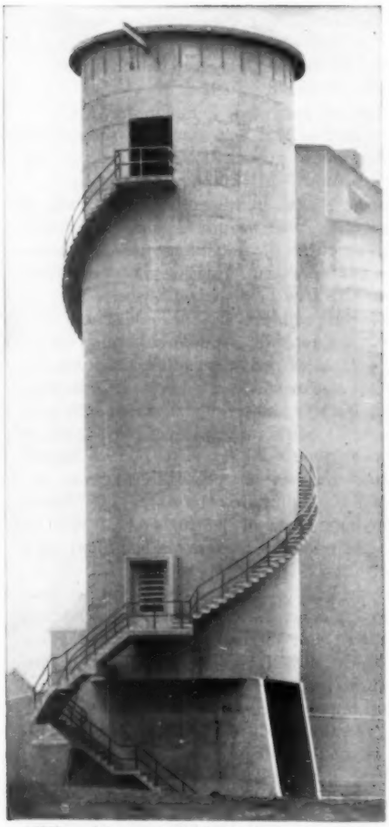
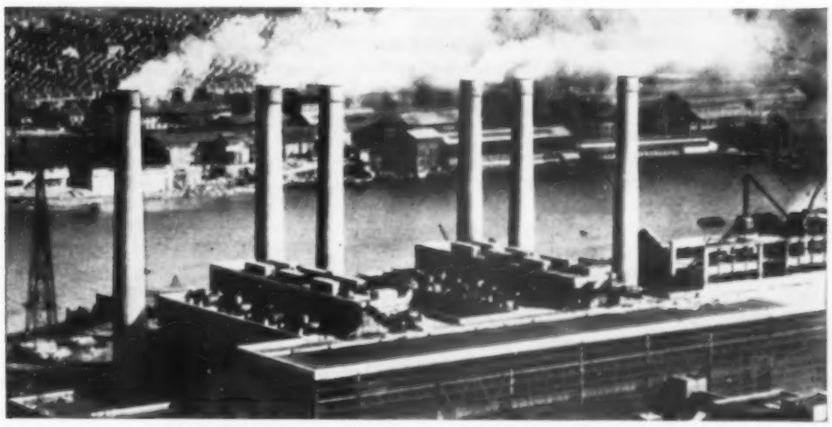


Silo with monolithic stairway at West Thurrock.



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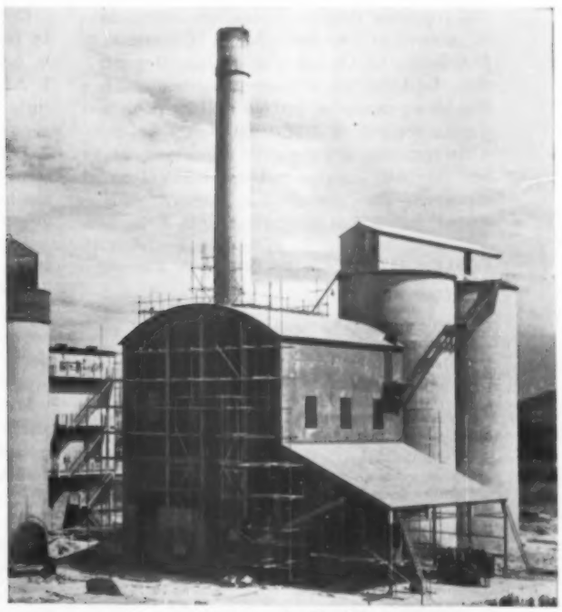

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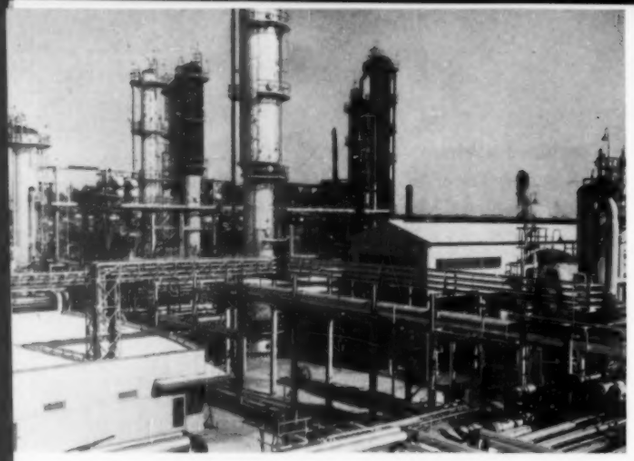


Fractionators for purifying propylene and ethylene at Phillips Petroleum Co.'s Sweeny, Texas, refinery (Phillips photo).

TABLE 2 Estimated 1956 Distribution Pattern for IPA

	%
Acetone	57
Solvent	12
Anti-stalling and de-icing agent	10
Other (about two-thirds chemical)	21

Following a great upsurge during the 1940's, acetone itself has shown only little growth in recent years: USA production in 1951 was 560 million pounds. In subsequent years, output of this commodity dropped (to a minimum of 440 million pounds in 1954), but has now, once again, grown to an estimated 600 to 620 million pounds in 1957.

This volume is well below installed capacity, estimated at 800 million pounds per year during the early part of 1957. In result, a strong buyer's market exists for acetone. This situation is not likely to be relieved in the foreseeable future. Even an optimistic forecast predicts a sales volume of about 800 million pounds no earlier than 1960. At the same time, byproduct acetone is becoming available in increasing measure from partial oxidation of lower paraffins (Celanese, Warren), from manufacture of hydrogen peroxide (Shell Chemical Co.), and from the cumene-hydroperoxide route to phenol (Hercules, Allied Chemicals, Standard Oil Co. of California). Beyond that, facilities for IPA-acetone production are being expanded by 150 million pounds during the period 1956 to 1958.

Solvent uses are the most important outlets for both acetone and its chemical derivatives. The distribution pattern estimated[2] for 1957 is shown in Table 3.

TABLE 3. 1957 Distribution Pattern for Acetone

End Use	*Millions of Pounds*
Derivative solvents:	
Methyl isobutyl ketone and carbinol	195
Others (mesityl oxide, diacetone, hexylene glycol, isophorone, etc.)	60
Methyl methacrylate (via acetone cyanhydrin)	75
Miscellaneous chemicals and drugs (*bis*phenol-A, chloroform, etc.)	80
Paint, varnish, and lacquer solvent	65
Cellulose acetate solvent	60
Acetylene solvent	30
Miscellaneous solvent, etc.	50
	615

A study of recent trends shows that direct solvent applications of acetone have actually suffered a decline, due primarily to cutback in its use as cellulose-acetate solvent. The area of most important growth has been in the production of nonsolvent chemical derivatives—notably of methyl methacrylate (a monomer for plastics). Volumewise, the demand and outlook for these derivatives is, however, of secondary importance, and acetone's future expansion will continue to depend, in the first instance, upon its own and its derivatives' solvent uses. Among the latter, methyl isobutyl ketone and carbinol have been exhibiting the strongest growth trend.

Methods for Isopropanol Production: As we have seen, isopropanol is by far the most important chemical consumer of propylene. The conversion involves hydration of the olefin, i.e., in addition to one molecule of water:

$$CH_2{=}CH{-}CH_3 + H_2O \rightarrow CH_3{-}\overset{OH}{\underset{|}{C}}H{-}CH_3 \quad \ldots\ldots\ldots (1)$$

Two fundamentally different approaches are available for commercial execution of this reaction: (1) two-stage conversion in the liquid phase, and (2) vapor-phase hydration.

Commercially, the liquid-phase process is by far the more important. It is carried out in two reaction steps:

1. Absorption of propylene in strong sulfuric acid, causing formation of the isopropyl ester of sulfuric acid.
2. Dilution of the reaction product from step (1)—thereby effecting hydrolysis of the isopropyl esters to isopropanol, and regenerating sulfuric acid in dilute form.

Acid concentration for the esterification step is normally chosen near 85% by weight. Higher strengths are precluded by the excessive occurrence of coking and polymerization reactions; lower concentrations are not satisfactory because rate of propylene absorption is too small.

For the formation of the desired monoisopropyl sulfate, the ideal acid concentration is 84% by weight—which would, in theory cause no buildup of free water in the system. Actually, the occurrence of side reactions modify this picture, and provide the reason for selection of low acid strengths. Most important among these secondary reactions is the formation of diisopropyl sulfate. It has been shown that formation of this ester is heavily impeded by the presence of free water.

The main reaction system is controlled by the equilibrium relation between propylene, isopropyl sulfate, and isopropanol. According to Schrage and Amick,[3] only about 35% of absorbed propylene is present as the sulfate when the starting acid concentration is 80% and olefin:acid ratio is 1.0. As the acid strength is lowered, there is a rapid decrease in the amount of propylene which is present as the ester. In 35% acid, isopropyl sulfate accounts for only 4% of the total absorbed propylene. This shift in equilibrium is, of course, the basis for the commercial two-step process of isopropanol synthesis.[4]

The effect of operating variables in propylene esterification has been studied by Schultze.[5] Acid concentration was found to be both rate- and yield-determining. Pressure and temperature variation had a less pronounced effect.

Rate of propylene take-up in 75% sulfuric acid at 20 C was extremely slow, even when olefin pressure was raised to 120 psig.

In 95% acid, on the other hand, rate of absorption was so rapid that practically nothing further could be gained by boosting the operating pressure. At this high concentration, however, the mono-ester is not stable, and heavy yield losses occur due to formation of diisopropyl sulfate or ether, as well as of polymerization products.

Best performance is obtained with 85% acid. Here, pressure up to about 120 psig (at 20 C) has significant accelerating effect on propylene take-up. After 4 to 6 hours' contact time at 120 psig, the acid has attained its optimum content of 1.68 moles propylene per mole sulfuric acid; 76% of this propylene is present as isopropyl sulfate.

Hydrolysis of isopropyl sulfate to isopropyl alcohol is accomplished by adding enough water to reduce acid concentration to 30% to 40% (propylene-free basis). The dilution is preferably carried out at elevated temperature (80 C to 100 C) to speed the reaction and to permit overhead removal of isopropanol as it is formed. Hydrolysis may be advantageously carried out in several stages at successively increasing temperature—with the last stage operated at the boiling point.

Effluent acid is essentially free of organic material. This stream is taken to a sulfuric-acid concentrator, where its strength is raised to the requirements of the propylene-absorption stage.

The overhead from the hydrolizers is condensed. This phase contains water, isopropanol, and about 5% diisopropyl ether, based on alcohol. The ether is topped off and extracted with water for recovery of contained alcohol. Concentration and purification of isopropanol are achieved by straight fractionation, followed by azeotropic distillation with benzene to obtain the product in anhydrous form.

Vapor-Phase Hydration: The classical liquid-phase process for isopropanol production has several shortcomings. Acid

consumption is high, and both investment and operating costs for upgrading dilute sulfuric acid formed in the process are significant. Furthermore, the method is plagued by severe handling problems and corrosion difficulties.

Considerable effort, therefore, has been directed toward effecting the hydration of propylene in the vapor phase and in the presence of solid catalyst. Several feasible processes are now available. The first commercial plant for the vapor-phase hydration of propylene was taken onstream in 1951 at the Wilton, England, plant of Imperial Chemical Industries. Another vapor-phase hydration process has been in use by Shell Chemical Co., at Deer Park, Texas, for several years to produce ethanol from ethylene.

The hydration of propylene is reversible. Its equilibrium constant has been found[7] to vary with temperature according to the following relationship:

$$\log Kp = \frac{1,890}{T} - 5,697$$

Formation of isopropanol is favored by the use of low-temperature high-steam: olefin ratio and operating pressure. The maximum amount of steam which can be present at a given temperature and pressure is, of course, a dependent variable, and it can be shown on thermodynamic grounds that the best conversion is achieved at steam saturation. If this condition is fulfilled, temperature actually has only a minor effect on conversion at equilibrium, as is shown by the following calculated values[6]:

Temperature, C	*Pressure, Atm.*	*% H_2O in Feed Gas*	*Propylene Conversion, %*
A. *Below steam saturation*			
100	1	50	8.9
150	1	50	2.8
200	1	50	1.0
250	1	50	0.4
B. *At steam saturation*			
100	2.0	50	17.5
150	9.7	50	20.2
200	31.7	50	21.5
250	81.0	50	22.5

Similarly, the effect of water: olefin ratio is not very pronounced at conditions which provide steam saturation of the system:

Temperature, C	*Pressure, Atm.*	*% H_2O in Feed Gas*	*Propylene Conversion, %*
275	202.0	30	18.3
275	152.0	40	21.2
275	121.0	50	22.9

In the light of these findings, it will be desirable, in any event, to operate at steam saturation pressure. Catalyst activity then becomes the controlling variable. A highly active catalyst permits operation at commercially feasible rate by the use of relatively low temperatures and, therefore, of relatively low system pressure.

Of the numerous catalysts claimed for direct hydration of olefins, only two—supported phosphoric acid and promoted tungsten oxide—are so far of commercial interest. In the Shell ethanol process, phosphoric acid on Celite is employed. Activity of this catalyst is affected by moisture absorption at elevated pressure and at high steam: ethylene ratios. Rise in temperature has a favorable effect on catalyst activity; but, unless compensating adjustments are made in the other process variables, the equilibrium is shifted to lower possible ethanol concentration in the product.

Thus, activity of the phosphoric-acid catalyst is a variable dependent on other process conditions. It is adversely affected by conditions which favor alcohol formation, and operating conditions are chosen on the basis of economic compromise. Nelson and Courter[8] report that ethylene hydration in the Shell process is 4.2% per pass. Similarly, Runge[6] found propylene conversion over phosphoric-acid catalyst to be limited to 5.2% per pass if catalyst deactiviation by dilution was to be avoided.

Operation at such low conversions makes it necessary to operate with high recycle ratios and, therefore, requires a concentrated olefin feed—which is not called for in the liquid-phase (sulfuric-acid) process described above. A further disadvantage of low conversion per pass is the formation of a crude alcohol in high dilution—with consequently larger concentrating costs.

The limitation to conversion over phosphoric acid is set by this catalyst's propensity to absorption of water at the high partial pressures of steam which would favor alcohol formation. This shortcoming is absent in promoted tungsten oxide.

In the hydration of propylene over catalysts of this type, Runge obtained conversion up to 8.8% per pass and yields of 94%, by operating at 260 C to 320 C with steam saturation of the feed gas (at 80 atm. to 200 atm.). Full activity was maintained even after more than 1,000 hours onstream.

The condensed alcohol product obtained by vapor-phase hydration of propylene at these conditions contained about 34% isopropanol; n-propanol was formed as by-product in significant amount. Formation of this compound over unpromoted tungsten oxide, or over phosphoric acid, is of minor importance. In the latter instances, the principal byproduct is diisopropyl ether —which also accompanies isopropanol production by the liquid-phase method.

Catalysts of the promoted tungsten-oxide type have also been operated on a pilot-plant scale in the vapor-phase hydration of propylene at Gendorf, Germany. In this instance, the preferred catalyst was zinc-oxide-promoted 20% tungsten oxide on silica gel which had been reduced in a stream of hydrogen. With this catalyst, the optimum hydration temperature is 225 C. Operating pressure was 100 atm. to 200 atm.

In the work at Gendorf, some liquid water was allowed to be present in the reaction zone so that the system was completely saturated at all points of the reactor. The trickle technique, employing parallel flow of the two phases, was used.

At these conditions, (ultimate) alcohol yield is reported at 94% to 95%. The condensate contains up to 20% isopropanol. Standard distillative techniques serve to purify and upgrade this crude product to its azeotropic composition (91% alcohol). Further concentration is achieved by azeotropic distillation methods.

Acetone by Isopropanol Dehydrogenation: Fig. 1 shows that acetone may be obtained from propylene by four different routes, and that three of these involve the production of isopropanol as intermediate. Two of the methods, leading via isopropanol, yield acetone only incidentally to the manufacture of hydrogen peroxide and allyl alcohol, respectively. These processes, which are of recent origin, will be discussed in a subsequent part.

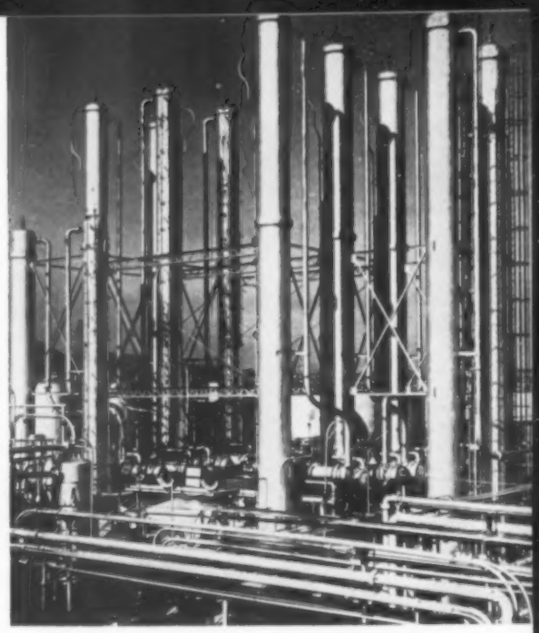
But the principal method for the production of acetone serves no other purpose. It involves the catalytic dehydrogenation of isopropanol:

$$CH_3-\underset{OH}{C}H-CH_3 \longrightarrow CH_3-\underset{O}{C}-CH_3+H_2 \quad \ldots\ldots (2)$$

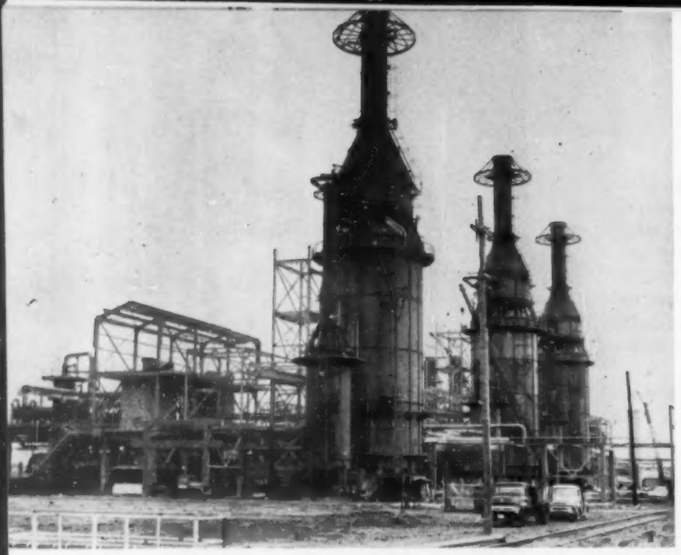
This reaction is carried out in the vapor phase. Numerous catalysts have been described in the literature, but indications are that commercial operation is based chiefly on the use of supported zinc oxide.

In the dehydrogenation of isopropanol, the reaction equilibrium shifts in favor of acetone formation as the temperature is raised. Practical conversion levels can be attained above 300 C; equilibrium conversion at 325 C is 97% of theory. The actual

(Continued on page 156)



IPA and acetone distillation columns at Shell Chemical Corp.'s Martinez, Calif., plant (Shell Chemical Corp. photo).



Battery of mammoth Petro-Chem steam superheaters at Neches butadiene plant: Small heaters at left of each superheater are butylene preheaters. Even smaller furnaces, for heating catalyst-regeneration air, are not seen in this view. Catalyst chambers are at left, above waste-heat boilers (photo courtesy Petro-Chem Development Co.).

One of the three new Neches butadiene units, shown at left, compared with an earlier unit with box-type preheaters and superheaters in right foreground: Air-compressor battery is at left of new heaters, behind which are towers for removal of ketones from steam condensate. 20-cell cooling tower and new Vogt boiler plant are at upper right (photo courtesy Foster Wheeler Corp.).

Neches Butane Products Co. increases butadiene capacity

NECHES BUTANE Products Co., Port Neches, Texas, is currently completing a major addition to its Gulf Coast butadiene plant. New facilities going on stream this month will produce 100,000 short tons of butadiene per year, increasing the plant's capacity by 50%.

The old plant which dates back to the World War II emergency and the new dehydrogenation facilities will use a new catalyst which will have the combined effect of increasing output about 100,000 t/yr without change in volume or type of feed. The new type "B" catalyst was developed by Dow Chemical Co.

The Neches plant for some years had been producing about 15% of the nation's supply of butadiene. Capacity percentage dropped to around 10% at the end of 1957 due to the completion of a number of new plants which raised USA capacity above a million tons per annum. The new addition and the catalyst charge brings output capacity of the Neches Butane Products Co. to an even larger share of existing capacity. Designs for the new addition were created by Foster Wheeler Corp., which also acted as prime contractor during construction.

The Neches plant draws its raw material by pipeline from nearby oil refineries. The mixed C_4 stream containing approximately 35% butylene is charged to a feed preparation section in which the butylene content is concentrated by cold sulfuric acid extraction of butylene and furfural extractive distillation for removal of saturates. Charge to the reactor contains approximately 85% butylenes; its conversion is as follows:

In the conversion process proper the butylene concentrate is preheated and mixed with superheated steam at a ratio of one part hydrocarbons to 20 parts steam before charging to the reactor. Effluent from the reactor passes through a waste-heat boiler and then the mixture is quenched with a cold-water spray, the steam condensed, and separated from the product gases. These gases, containing approximately 25% butadiene are compressed and routed to the butadiene recovery system.

The process steam condensate is treated for removal of ketones and is returned to the main steam generation plant. A 20-cell, 70,000 gpm Foster Wheeler cooling tower has been added to augment cooling water supply. Each of the three new reactor sections uses two reactors which are cycled in half-hour periods. Regeneration air is cycled and compressed to 45 psia in a battery of 850-hp Ingersoll Rand compressors driven by Worthington engines.

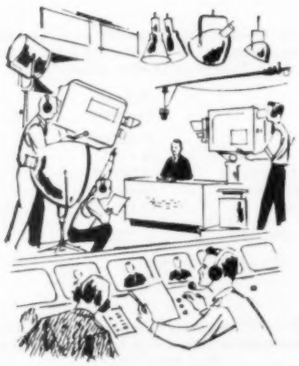
Due to the severity of the high temperature operation, stainless steel is used extensively in the reactor heaters and piping. Piping in diameters up to 54 inches is carbon steel with a stainless-steel sleeve and internal insulation. Radiant tubes in the steam superheaters are of stainless steel.

The three huge vertical-fired steam superheaters designed and constructed by Petro-Chem Development Co. Inc. are an impressive feature of the plant. Each furnace is over 160 ft high and 31 ft 6 in. in diameter, and has a heat-absorption capacity of 150,000,000 Btu per hour. The furnaces are believed to be the largest units installed in the USA for chemical processing. In addition to these three large superheaters, Petro-Chem also supplied the butylene and air heaters for the Port Neches project.

The Petrochem-Isoflow superheaters have other unique design features in addition to their massive proportions. They are one of the first types in which each tube section of each pass was designed for its own particular pressure-temperature conditions and made of alloy material and thickness to satisfy these conditions. The pressure and temperature rating for each tube section was stamped on the tubes. The operating tube-wall temperatures of the superheaters will be in the unusually high range of 1,800 F to 1,900 F. Inlet pressure will be in the range 100 psi to 150 psi, and outlet pressure 50 psi at 1,350 F to 1,400 F. Each of the three furnaces will superheat 271,000 lb per hour of steam. Saturated process steam is generated by a new Henry Vogt plant. The 18-pass header of the furnace, with six tubes in each pass, is of a unique design to gain maximum heating efficiency.

Goodrich-Gulf will construct additional facilities at Port Neches for the manufacture of carbon-black master batch rubbers. The new facilities will cost in excess of $1 million, and are designed to produce a new type of dry rubber containing carbon black. Completion is scheduled for late 1958. The addition will be engineered and built by the Catalytic Construction Co., Philadelphia. END

there's more to Cities Service than meets the eye!



Behind the performers on even the simplest television show is at least one writer, producer, director, camera crew, prop man and engineer—to say nothing of the fantastic network of electronic equipment that transmits their efforts to you.

Even the largest TV screen is comparatively small in area—but it is a window on the world.

The newscaster who brings a summary of the day's events appears alone on this screen, but behind him—unseen by the TV audience—are thousands of men and women who made his program possible. They include the people who designed and built the facilities of TV transmission, cameramen, technicians, script writers, directors, producers, newsmen throughout the world, and many others.

Producing gasolene is like that. To provide the motor fuel which flows from pump to car requires a host of people who must find and produce the crude oil, refine it, test it in laboratories, transport it to distributing points, and finally deliver it to the station tanks to await the customer's order to "fill 'er up."

In the case of Cities Service, one of the nation's leading oil companies, all this required a capital investment of more than $179,000,000 in 1957 alone. It is money well invested, for petroleum products are vital to modern living—second only in importance to food itself.

CITIES SERVICE

Lower exports—higher taxes retard Italian refining

by A Girelli

With excess capacity for domestic requirements, Italian refiners have found it necessary to operate at reduced rates because of lack of export business

THE Italian refining industry, whose overall crude capacity is presently 700,000 b/d, needs a very large and steady export flow. Internal demand is only about one-third the present capacity, and is increasing very slowly—particularly in the case of gasoline and distillates. Though slightly above the 1956 level, 1957 exports were insufficient to assure a profitable level of refining operations.

Crude runs in 1957 and the products distribution pattern of Italian refineries are reported in Table I. There was an increase of crude runs to stills of 7%, due mainly to activity in the second part of the year, the first part having closed at about the same level as in the preceding year. Percentage increase, however, is lower than 1956 over 1955 (10.7%).

Table I shows that the quantitative improvement has been accompanied by a qualitative shift toward the less valuable heavy products. The quality variation had a depressing action on the overall profits of the Italian refineries because, at the same operating level, the upgrading of the raw material to finished products—which is the basis of the refining industry—is not carried out at the highest possible level.

Still worse is the pattern of petroleum products exports, which used to be the safety valve of the overexpanded Italian refining industry. A comparison should be made not only of the past two years, but also of preceding years. From 1954, record year for Italian oil products exports, the decrease in exports has been more than 821,000 metric tons, or about 13% (see Fig. 1).

The impact of the changing picture is shared differently among the four main products, viz., gasoline, kerosine, gas oil, and residual fuel. Gas-oil export is increasing, residual fuel decreased only slightly from 1954 to 1957, and the burden of decline fell mainly on the light ends. In the period of the highest expansion, gasoline accounted for 28.7% and kerosine for 9.6% of the total oil-products export. In 1957 the two products alone accounted for the 26.8% and 5.5%, respectively, of exports.

From these figures, it can be seen that particularly hit by decreased exports are the high-priced products—which, as shown above, do not find a ready market within the Italian borders owing to the high taxation which does not encourage private motoring. A decrease of taxation on kerosine for domestic heating, approved last fall, did not appreciably stimulate kerosine sales. Italians are not accustomed to such a fuel for heating purposes; and, where

Table I—Italian Crude Runs to Stills and Products Distribution, 1956-57

	(Metric Tons)	
Crude Run to Stills	**1956**	**1957**
Imported crude	18,491,554	19,549,341
Domestic crude	496,446	1,077,202
Residual imported and domestic	298,310	91,583
Products		
Gasoline	3,098,225	3,080,952
Korosine and jet fuel	1,135,092	1,035,285
Gas oil and diesel	3,994,376	4,354,594
Lubricants	167,547	149,544
Residual fuel	8,508,101	9,621,411
Petroleum coke	172	127
Asphalt	439,439	453,160
White spirit	42,411	26,940
LPGas	333,374	391,169
Others	34,925	28,897

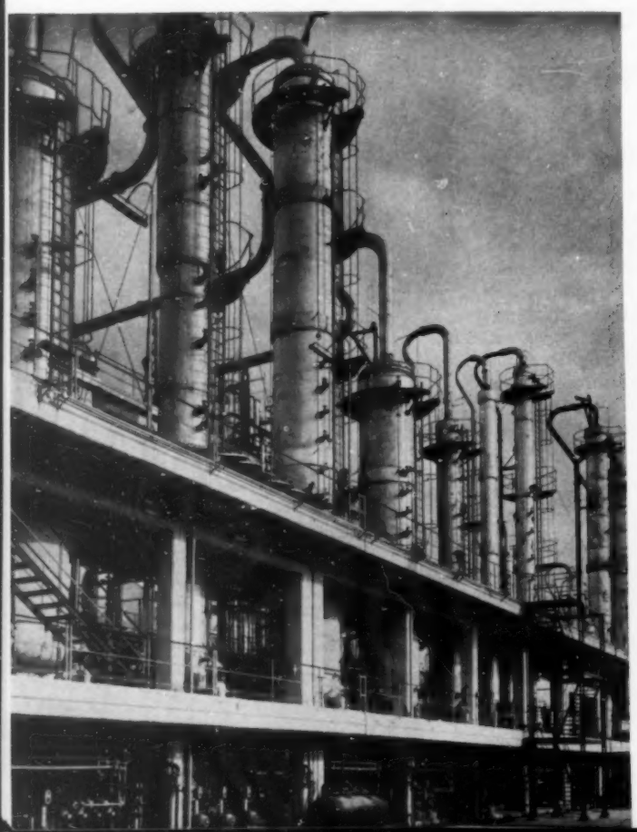
Table II—Refining Capacity and Internal Consumption* of Petroleum Products in ECM Countries (Metric Tons)

	Refining Capacity	Consumption
Italy	28,000,000	10,874,000
France	24,118,000	18,939,000
Belgium-Luxembourg	6,568,000	5,082,000
Germany (West)	14,384,000	14,144,000
Netherlands	12,467,000	6,713,000
Total	85,537,000	55,754,000

*Italian data for 1957, other for 1956.

Table IV—Italian Catalytic Reforming and Gas-Oil Desulfurization Units Being Erected or Planned (Mid-Year 1957)

Refinery and Location	Catalytic Reforming	Gas-Oil Desulfurization
	(Thousands of Tons Per Year)	
Aquila, Trieste	117	235
Esso Standard, Trieste	34	—
Sarom, Ravenna	—	300
Stanic, Leghorn	—	400
Mobil, Naples	435	670
Stanic, Bari	305	405
Rasiom, Augusta	285	—
	1,176	2,010



Montecatini plant at Ferrara, north-central Italy, for production of styrene monomer (Montecatini photo).

there is no central heating, LPGases or solid fuels are preferred.

So far as gasoline is concerned, after the Suez crisis a 14-lira-per-liter increase in sales tax—which will continue at least to the end of October 1958, further depressed gasoline sales. Purpose of the tax increase is to reimburse the importers for the increased cost of crude (increased tanker rates and crude prices) carried at the time of the Suez Canal closure.

The future does not appear bright. Preliminary statistics for the first months of 1958 indicate a decline in gasoline and distillate exports—with increased residual-fuel export. Long-term forecasts anticipating the European Common Market treaty when in full operation—so far as the refining industry is concerned, are rather uncertain for Italy whose refining capacity is more inflated, with scant hope of increasing exports as compared with member countries. Italy's refining capacity, compared with these other countries, is shown in Table II.

Export to non-ECM countries does not promise any expansion; almost all the consuming countries have erected their own refining facilities, and tend to supply the entire range of finished products. In the early months of recent years, exports to countries outside of Europe were extremely low; Mediterranean countries accounted for 23% to 25% of the Italian exports, against the 62% to 64% of the European countries.

An obstacle to the future development of the inter-European trade of petroleum products of Italian origin lies in the similarity of the consumption pattern of the ECM member countries, which is shown in Table III.

The technological development of Italian refineries kept improving, sparked by the economic situation which has been briefly outlined and which has been a constant stimulus to quality improvement. In particular, catalytic reforming has attracted the attention of Italian refiners, as in preceding years. Almost every refinery is currently equipped with the most up-to-date catalytic processes. Existing plants are being expanded to keep pace with the octane level of motor gasoline which quickly returned to the high preSuez level (regular-grade 84 to 86 RON, premium-grade 98 to 100 RON).

Several of the larger refineries are also considering gas-oil desulfurization, which permits a decrease to nominal levels of the high sulfur content of Middle East gas oil. Hydrogen for the operation is supplied by reformer light gases. Consideration also is being paid by larger refineries to sulfur recovery. The first plant for sulfur recovery has been operating for two years at the Condor refinery near Milan. The unit was erected with the particular aim of suppressing air pollution, but resulted profitably in the overall refinery pattern.

Catalytic reforming (mainly expansion of existing plants) and gas-oil desulfurization units, expressed in metric tons per year capacity, are indicated in Table IV.

Cracking capacity is not being expanded, for the economic reasons stated above. Existing units are generally operated at the lowest convenient level in order to keep low the yield of light ends, which do not find a ready market.

Development in the petrochemical field has continued satisfactorily. Research now carried out on different fundamental and applied aspects of new and improved products has provided some interesting results. In the field of polymers, work has been active, on the fundamental side, at the Department of Industrial Chemistry of the Politecnico, in Milan, under the supervision of Professor G. Natta. Research on stereospecific catalysis resulted in new and improved materials of petroleum origin (isotactic polyolefins, isotactic copolymers), of possible use for fibers, plastics, and elastomers.

On the commercial side, Montecatini has expanded the capacity of several petrochemical units. "Moplen" isotactic polypropylene, produced via the Natta process of stereospecific polymerization at the Montecatini works in Ferrara, is finding a ready market in Italy and abroad—production (6,000 tons per year) being still short of increasing demand.

Steam-cracking capacity at the Ferrara works of Montecatini is being quadrupled. The plant is supplying the raw material for a series of chemicals ranging from alcohols to polymers.

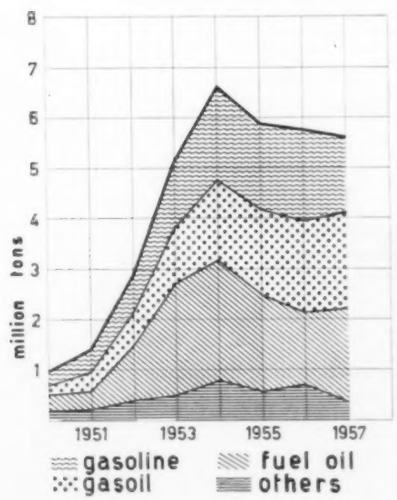
ENI is completing its large project for GR-S rubber and nitrogen fertilizers at Ravenna. Production will start on natural gas from nearby fields, and from butanes supplied by oil refineries. Part of the complex was officially dedicated last April.

END

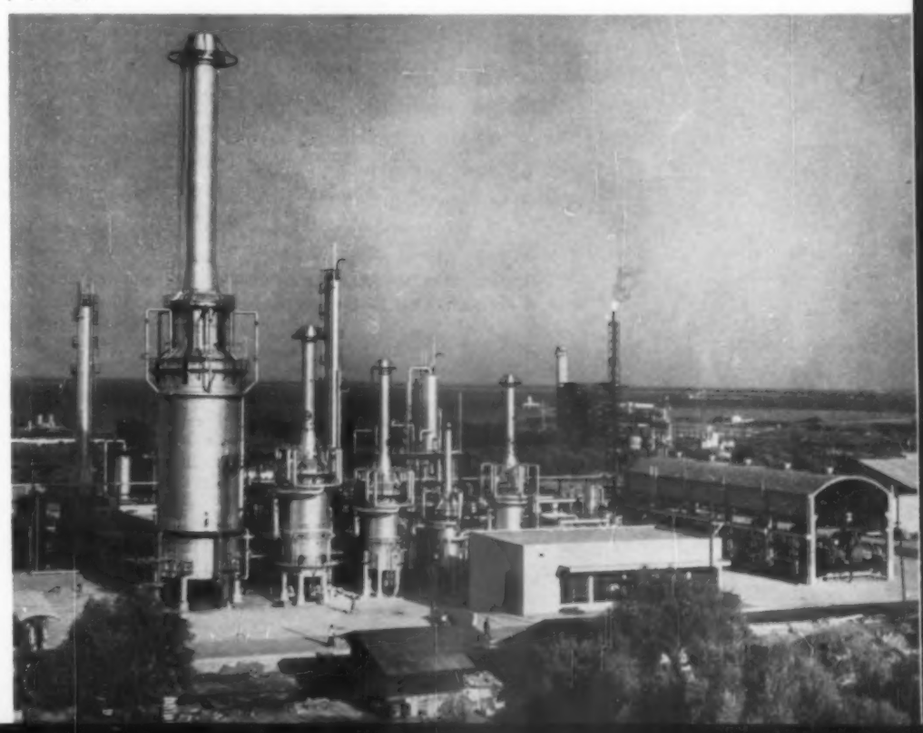
Table III—Consumption of the Four Main Products in the ECM Countries (1956)

	Gasoline	Kerosine	Gas oil	Residual fuel
France	28.1	1.1	31.2	39.6
Germany	29.6	2.2	42.9	25.7
Belgium-Luxembourg	27.0	1.9	26.7	34.4
Netherlands	15.6	6.5	26.4	51.1
Italy	14.0	2.8	17.9	65.3

Fig. 1 Exports of petroleum products from Italy, 1950-57 (millions of metric tons per year).



Reformed gasoline up to 100 ON (Research), unleaded, can be produced at the Powerformer of the RASIOM refinery at Augusta, Sicily. Erected by CTIP, Rome, under Esso license, the plant has a capacity of 7,300 b/d.



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Facilities to be added in the expansion program now under way by ANCAP at its La Teja refinery at Montevideo, Uruguay (drawing courtesy M. W. Kellogg Co.).

Refinery expansion plans in Latin America

Modernization and expansion activity in Latin America is centered in the nations in which consumption is growing at the most rapid rates. Argentina, Brazil, Venezuela, and Uruguay all have important projects under way

by Bernardo Rikles

Argentina: Recently the new president of Argentina, Arturo Frondizi, delivered his first presidential address to the joint houses of the national congress. In it, he pointed out with complete frankness the dramatic economic situation of the country—with the national treasury exhausted, a deficit of US $764 million in its commercial balance during the past three years, imports of crude and products valued at $318 million in 1957, and a national budget which outruns total internal revenues by 46%.

The new president also pointed out that, although his government welcomes foreign investors, there will be no oil concessions nor relinquishment of State dominion over its oil resources. He added, in his address, that intensive exploitation of oil fields tending to self-sufficiency in the supply of liquid fuels is the shortest path to the welfare of the people of this country, and that he considers this activity so essential that he will take over personal management of the State-owned oil company, Yacimientos Petroliferos Fiscales. This means that YPF will rank as a ministry, and final decisions will be made by the president himself—thus giving YPF complete autonomy, as requested so often by the present management of the company. As a matter of fact, Frondizi is reproducing the conditions existing during Irigoyen's presidency, when Mosconi—personal and trusted friend of Irigoyen, then in charge of YPF—would call directly on the president for final decisions. This, indeed, will be an interesting experience, and may help clear up the whole Argentine oil complex in a relatively short time (say, from two to three years).

From now on, YPF should have complete financial support and facilities from all government agencies for completing its reactivation plan and developing its oil fields—which, according to president's message, have more than 415 million metric tons of oil equivalent in proved reserves of liquid and gaseous hydrocations.

In view of what I would call the "Frondizi oil experiment," it would be advisable —until the results of such an experiment are well established—that Argentine congressmen refrain from oil legislation—particularly in view of the fact that the great majority have come out in favor of State oil monopoly during the pre-electoral campaign.

Statistics at hand show that—despite government measures leading to restriction in utilization of liquid fuels, the downtrend of the country's economy which is nearing internal and external bankruptcy (as Frondizi points out), unfavorable international trade, unstable labor conditions, and government uncertainty in the solution of its financial and economic problems, as well as its indecision toward foreign private investors—fuel consumption has kept a constant upward trend.

Table I gives consumption of liquid fuels, in metric tons of oil equivalent, during the five-year period 1952-56. Although 1957 figures are not as yet available, consumption has been estimated at more than 12.5 million tons of oil equivalent, about 3% over 1956 consumption—this increase due mainly to heavy distillates and residual fuel. It should be pointed out that gasoline consumption has remained practically stagnant since 1954. Working against gasoline consumption have been the high cost of cars, with import duties ranging between US $2,000 and $9,000, according to weight and make of car; high cost of spares; gasoline at 12 pesos per liter (42 US cents per gallon at official rate of exchange, at which oil is imported, or US 19 cents at free rate); poor condition and shortage of highways and roads, etc. The important increase in diesel-oil consumption is due to the dieselization of railroad locomotives and truck transportation, and that of kerosine to an increase in standard of living and shortage of gas fuels. It should be pointed out that the Campo Duran-Buenos Aires gas line, already under construction, will help satisfy people's demand for natural gas for domestic and industrial fuels. Gas del Estado (State-owned company with monopoly of gas fuels in Argentina) has an ambitious expansion program—having succeeded in obtaining a government decree to increase the price of gas by 0.20 peso per cubic meter consumed, in order to provide funds for the company's development.

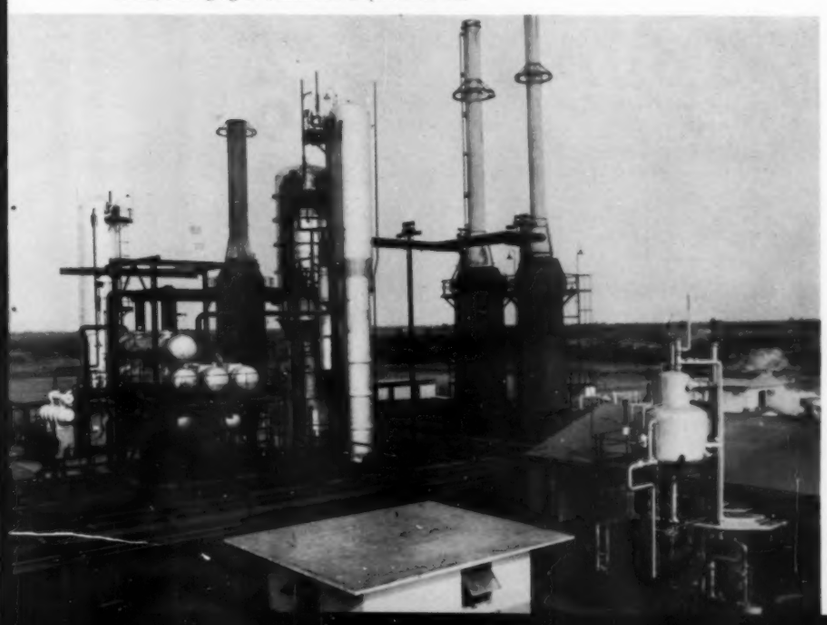
As shown in Table II, total oil processing capacity of local refineries (including 1957 expansion) amounts to 243,000 b/d. Crude runs to stills in 1957 totaled 210,000 b/d, or 87% of capacity. Runs for 1958 are estimated at 233,500 b/d, 97% of present capacity. As shown in Table III, 55% of the crude processed was imported mainly from Venezuela and the Middle East; estimates for 1958 reduce this proportion to 47%, or 110,000 b/d, due to an expected increase in local oil production by YPF. These figures and the trend of future consumption—bringing it to a minimum of 16.5 million tons of oil equivalent by 1962—show emphatically that refining capacity in Argentina must be increased substantially.

One private company (Esso) has completed its project for a 47,000-bbl pipe still and issued calls for tenders for primary equipment—for expected completion by early 1960. YPF has given M. W. Kellogg an order for engineering and construction of its Lujan de Cuyo refinery expansion which will bring daily processing capacity to 42,000 bbl. The new plant is to be integrated with desalting, pipe still, delayed coking, catalytic cracking, and liquefied-gas recovery facilities. This new 28,000-bbl plant has been designed to produce low cold-test fuels from Mendoza high paraffinic crude. Its delayed coker may be run on residuum for producing residual fuels, if and when the market requires. The State company also is planning to build a 38,000 b/d refinery in Bahia Blanca to run on Neuquen crudes. The new refinery—designed mainly for liquid-fuel production—will have topping, thermal cracking, and LPGas-recovery units among its facilities.

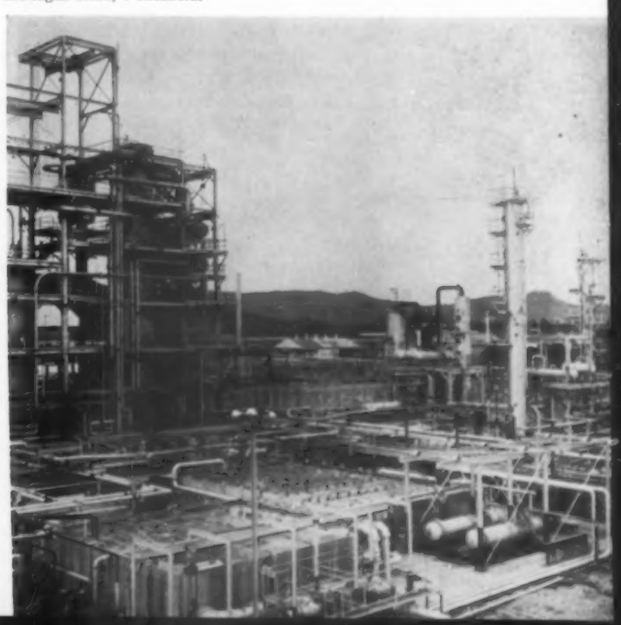
Oil refiners in Argentina are carrying out modernization programs. The more pressing ones are under way, and those requiring large investments are being deferred awaiting means for their financing, as in the case of YPF, and a clearer view as to their future in the case of private oil companies. Among modernization programs under way may be mentioned the methylethylketone dewaxing plant under construction at the refinery of Diadema Argentina, in Dock Sud. This job has been awarded to Foster Wheeler, and completion is expected early in 1960. Among the deferred projects are the 13,000 b/d cat cracker authorized for Esso Standard by a government decree last year—with an investment of US $2.5 million for imported materials and equipment. Also should be mentioned the YPF lube plant with a capacity of 120,000 tons of oil per year (2,400 b/d). This plant is to utilize the most modern processes for high-vacuum distillation, propane deasphalting, solvent treating and dewaxing, and clay finishing—to be located, according to latest information, at the San Lorenzo refinery. Catalytic reforming units are being planned by private oil refiners and YPF (the latter for the Campo Duran distillates in San Lorenzo). As a matter of fact, the need for reforming units is pressing. Gasoline marketed in Argentina during 1957 had an average octane rating of 72—with some premium grades ranging up to 78.

This refinery survey must include some of the outstanding Argentine petrochemical developments. Mention should be made of the 3,000-ton-per-year polystyrene plant begun in 1957 by Monsanto, located in San Nicolas, less than 100 miles from the great consuming center of Buenos Aires. Koppers (Industries Plasticas Argentinas Koppers) is building a 3,000-ton polystyrene plant in Villa Elisa, less than 50 miles from Buenos Aires. This plant was expected to begin operations on monomer, before June of this year. Electroclor (ICI) is building a polyvinyl chloride plant at its Juan Ortiz refinery near Rosario. This plant will use acetylene from calcium carbide. Comple-

Bajo Grande asphalt refinery near Lake Maracaibo, Venezuela, belonging to Richmond Exploration Co.



Caripito refinery of Creole Petroleum Corp., located in Monagas state, Venezuela.



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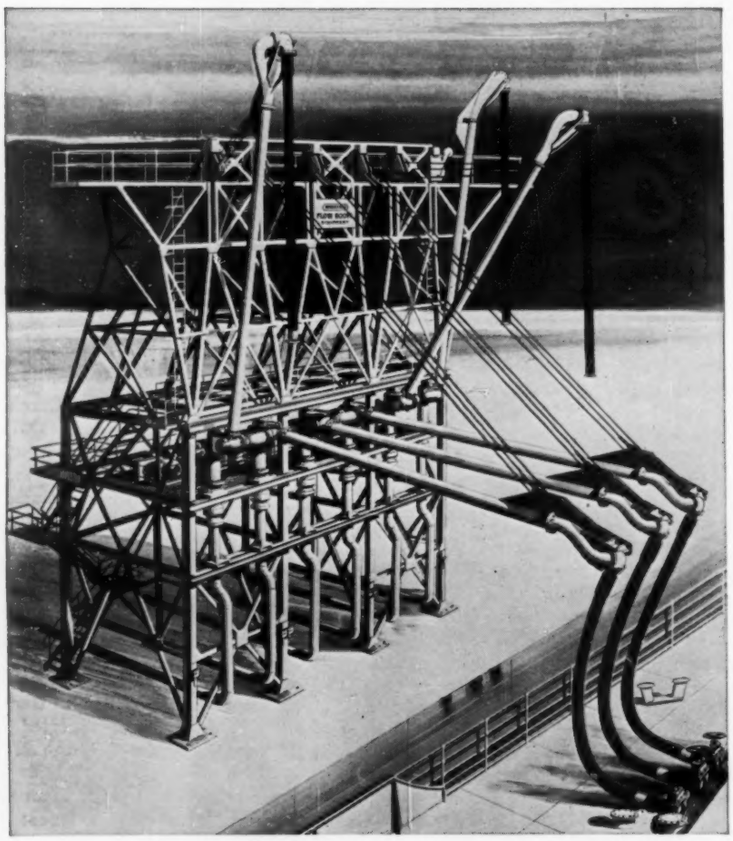

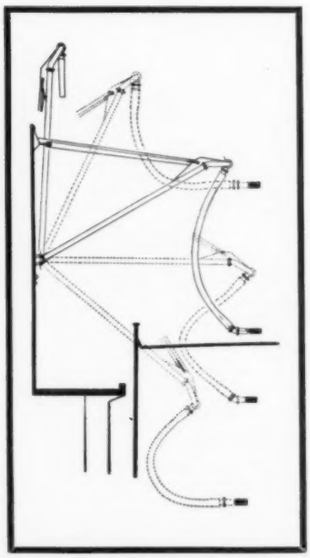

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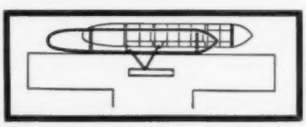

Diagram illustrating manner in which free slewing of Flow Boom permits safe tanker drift.

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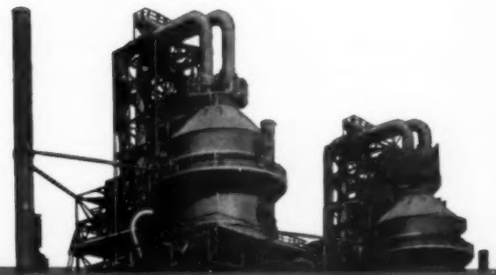

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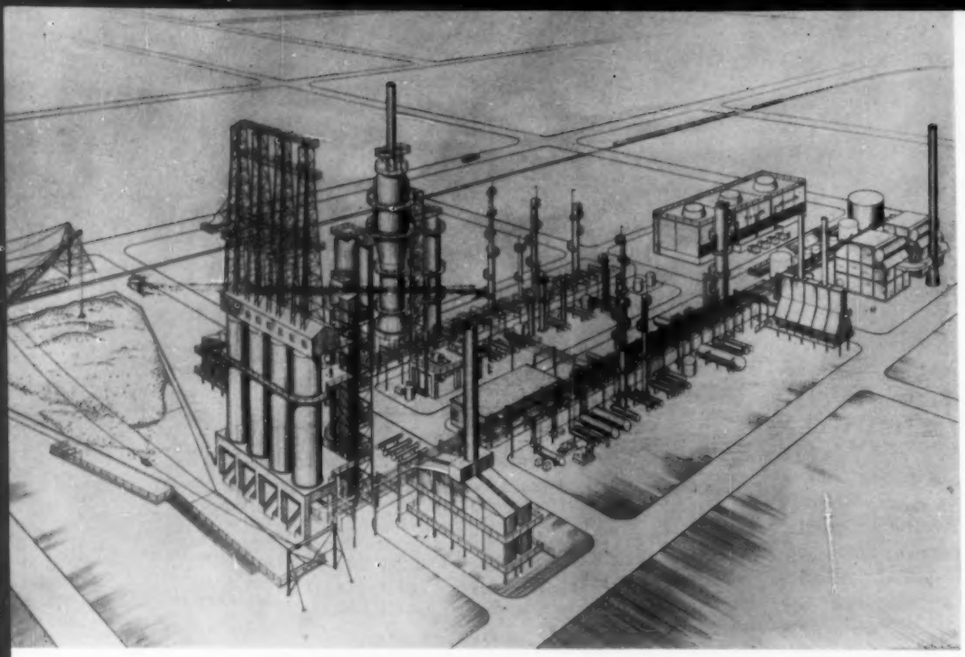


Artist's conception of the proposed new refinery to be built by the M. W. Kellogg Co. for YPF at Lujan de Cuyo, Argentina (M. W. Kellogg drawing).

TABLE I
CONSUMPTION OF LIQUID FUELS IN ARGENTINA
(Metric Tons of Oil Equivalent)

Petroleum Product	1952	1953	1954	1955	1956
Avgas	59,816	55,145	58,916	62,729	81,960
Gasoline	1,598,322	1,610,463	1,707,404	1,708,872	1,726,820
Kerosine	525,738	606,354	678,498	819,514	923,903
Tractor oil	247,491	227,097	237,635	226,792	210,628
Gas oil	393,890	492,354	649,228	813,219	758,347
Diesel oil	670,079	759,340	766,716	920,180	1,194,760
Residual fuel oil	5,255,813	5,389,222	5,803,031	6,444,833	6,857,689
Petroleum coke	100,086	98,720	93,193	104,234	107,438
LPGas	44,725	48,232	49,697	54,766	69,719
Natural and refinery gas	187,752	178,824	173,197	179,548	187,267
	9,074,695	9,465,751	10,217,515	11,334,687	12,118,531

TABLE II—ARGENTINE
PROCESSING CAPACITIES TO JULY 1958

		B/D	B/D
Argentina:			
Cia General Asfaltos	Wilde (B.A.)	370 L	
Esso Refinadora de Petroleo	Campana (B.A.)[1]	37,000 Comp.	17,500 T
	Bahia Blanca (B.A.)[1]	10,000 CS	5,000 T
	Manuel Elordi (Salta)	1,500 S	
	Dadin (P. Huincol)	500 S	
Condor	Lomas de Zamora (B.A.)	800 SL	
Diadema Argentina SA de Petroleo	Buenos Aires[2]	38,000 Comp.	9,000 T
La Isaura	Bahia Blanca	1,800 SC	1,000 T
Loterro y Papini	Avellaneda (B.A.)	800 SL	
Ragor SA	Quilmes (B.A.)	300 SL	
YPF (Ende)	Dock-Sud Avellaneda (B.A.)	5,500 Comp.	3,000 T
	La Plata[3]	100,000 Comp.	56,000 TC
	San Lorenzo (Santa Fe)	22,000 SC	13,000 T
	Lujan de Cuyo (Mendoza)	14,000 SC	9,000 T
	Chachapoyas (Salta)	3,500 SC	1,300 T
	Plaza Huincul (Neuquen)	2,800 SC	540 T
Petroquimica (E.N.)	Comodoro Rivadavia	4,800 SC	1,500 T
		TOTAL PROCESSING CAPACITY	243,000

[1] 47,000-bbl pipe still, on project for completion 1960.
[2] Methylethylketone dewaxing plant under construction; complete 1959.
[3] 18,400 b/d fluid catalytic cracking capacity and 7,000 b/d thermal cracking capacity.

TABLE III
ARGENTINE CRUDE OIL PROCESSED, LIQUID-FUEL YIELDS, AND IMPORTS DURING 1957

CRUDE PROCESSED (Thousands of Barrels Per Year)			YIELDS %		IMPORTS OF LIQUID FUELS (Thousand of Barrels)	
TOTAL		75,000	Gasoline	28.6	Avgas	420
NATIVE		32,900	Kerosine	9.6	Gasoline	280
C. Rivadavia	18,800		Tractor fuel	1.9	Kerosine	950
Mendoza	9,200		Gas oil	4.4	Gas oil	3,140
Neuquen	4,300 (est.)		Diesel oil	10.5	Diesel oil	1,820
Salta	600 (est.)		Fuel oil	44.8	Fuel oil	14,300
IMPORTED		42,100				
Venezuela	25,700					
Kuwait	12,500					
Peru	1,660					
Bolivia	1,040					
Colombia	700					
Ecuador	500					

tion is expected by 1959. Indupa (Pechiné) in Rio Negro, and Monsanto (in partnership with Carbonctal) in Mendoza, are planning the erection of PVC plants—starting with acetylene from calcium carbide. These two plants are in the project stage. Atanor, now producing methyl alcohol from wood coal, is planning enlargement of its methyl alcohol production—using as raw material natural gas from Campo Duran. Projects for this plant are well advanced.

Chile: In 1957, Chile produced 4,300,000 bbl of crude oil; processed 7,575,000 bbl; exported to Uruguay 367,000 bbl; and imported from Venezuela 3,800,000 bbl. Table IV gives consumption and imports of liquid fuels for the same year.

From the foregoing figures, and capacity of existing refineries in Concon and Manantiales of 20,000 b/d and 800 b/d, respectively, as well as future consumption forecasts made by Empresa Nacional del Petroleo (State-owned oil company) for 1960 and 1963, it was decided to expand Concon refinery capacity to 45,000 b/d.

A new 25,000-bbl pipe still—integrated with a 12,000-bbl catalytic gas-oil cracking plant, a 6,000-bbl catalytic reforming unit, and a 1,100-bbl alkylation plant for aviation gasoline and high-octane gasoline—will be erected by ENAP at its Concon refinery. The engineering, construction, and erection of the new plants, at a cost of some US $15 million, have been awarded M. W. Kellogg Co. Construction is to start by mid-1958, and completion is scheduled for early 1960. After expansion, Concon refinery will produce:

	Barrels Daily
Avgas	1,185
Gasoline[1]	16,000
Kerosine	3,050
Diesel oil	12,400
Residual fuel oil	8,600
LP Gas	85
Residual gas (in fuel equiv.)	651

[1] 80% of 78-octane, and 20% of 85-octane premium gasoline.

Brazil: Licensing agreements have been signed for construction of an 11,800 b/d Houdriformer as one of the major units in the new 90,000 b/d refinery being built by Foster Wheeler for Petroleo Brazileiro SA (Petrobras) near Rio de Janeiro, Brazil.

The new refinery, to be known as the Refinaria Duque de Caxais, is being built on a 2,000-acre site on Guanabara Bay, and is scheduled for completion during 1960. Petrobras is an integrated government-controlled corporation responsible for development of Brazilian petroleum resources.

Unit design also provides for production of aromatics (benzene, toluene, and xylenes) and aviation-gasoline blending stock. Houdry catalysts will be used in both the guard-case feed desulfurization section and the three catalytic-reforming reactors. Facilities are provided for catalyst regeneration *in situ*. Mechanical design and supervision of construction of the Houdriformer will be by Foster-Wheeler Corp., which has the overall contract for the new Petrobras refinery.

Capácity of the Petrobras plant at Cubatao will be increased to 100,000 b/d this year. Currently the refinery is processing 73,000 b/d, although stated capacity is only 65,000 b/d. An ethylene-recovery plant has been built to process effluent gases and a 340-ton-per-day fertilizer plant is operating.

Uruguay—A major refinery expansion and improvement program has been undertaken at its Montevideo refinery by ANCAP. Crude capacity will be increased to 41,000 b/d from 24,000 b/d, and other major units will be built. Cost of the entire project is estimated at $42 million. Work was begun March 17, and completion in 1959 is anticipated.

Crude capacity increase will be attained through the erection of a new topping unit. The present thermal cracking unit will be converted to vis-breaking service, and a 10,000 b/sd vacuum still will be built to supply charging stock for the new cat cracker. A coking unit will process residual oils and provide solid fuel for the power plant.

The catalytic cracker will be a type "B" Kellogg orthoflow unit with a fresh-feed capacity of 5,000 b/sd and a total charge of 7,000 b/sd. A Sinclair-Baker cat reformer, with a capacity of 3,000 b/sd, will be built.

New gas-recovery facilities will enable ANCAP to produce LPGas, and a new treating plant will be installed. An enlarged power plant will provide all electrical energy required for operations.

In 1957, ANCAP processed 1,200 b/d of crude from Chile and 24,600 b/d from Venezuela. Domestic consumption of various products for 1957 and the current year are as follows:

	Metric Tons	
	1958	*1957*
Solvents	10,000	9,000
Gasoline	358,000	348,000
Kerosine	205,000	201,000
Gas oil	162,000	157,000
Diesel fuel	40,000	40,000
Fuel oil	610,000	634,000
Asphalt	14,000	13,500
Total major products	1,399,000	1,402,500

Venezuela: A complete new major refinery, two new lube plants, and substantial additions to existing capacity are planned in Venezuela. Socony Mobil de Venezuela is building the $28 million new plant at the terminus of the new pipeline from Barinas. It will be located at El Palito, about eight miles west of Puerto Cabello, on the Caribbean coast. Construction is scheduled to begin early this year, and to be completed late in 1959.

The Amuay Bay refinery of Creole Petroleum Corp. has increased its crude refining capacity by 104,000 b/d by installation of a fourth atmospheric pipe still, which went onstream in September 1957. This brought the total design crude distillation capacity at Amuay to 328,00 b/d and this, added to the 60,000 b/d capacity of the Caripito refinery, brought Creole's total crude refining capacity close to 400,000 b/d.

Operation of a 17,000 b/d diesel-oil Hydrofiner was begun in January 1958. This unit can desulfurize Tía Juana medium diesel oil down to 0.2% from 1.0% by weight of sulfur. The reactor is of the fixed-bed type employing cobalt-molybdate catalyst.

A 700 b/d lube plant went onstream in May 1958. Tía Juana medium distillates are phenol-treated, hydrofined, and propane-dewaxed, and subsequently blended with purchased bright stock and additives to produce a full range of motor-oil and industrial lubricant products.

The Cardón refinery of Cia. Shell de Venezuela is an integrated plant of 203,000 b/d crude-oil rated capacity, and includes extensions which were officially inaugurated in November 1957—consisting of a 35,000 b/d catalytic cracking complex and a 2,500 b/d hydrofluoric-acid alkylation unit. In addition, an 80,000 b/d atmospheric distillation unit is in the final stages of construction and, when completed, will bring capacity to 283,000 b/d.

The Bajo Grande refinery of Richmond Exploration Co., an exceptionally modern and well designed plant, is being expanded sharply. Plans are to increase the capacity of the No. 2 unit to 15,000 b/d by the installation of additional heat exchangers and feed pumps; also to make the necessary additions to unit No. 3 so that it will produce solid (penetration) asphalts in addition to the other products mentioned. Capacity of No. 3 unit for the production of topped crude and heavy-viscosity fuel oils will then be approximately 23,000 b/d, and for solid asphalts about 8,500 b/d.

These additions will probably be completed during 1959. END

TABLE IV
CHILEAN CONSUMPTION AND IMPORTS, 1957

Liquid Fuels	Consumption (Thousands of Barrels)	Imports (Thousands of Barrels)
Avgas	378	378
Gasoline	3,550	442
Kerosine	1,370	1,190
Diesel	1,700	348
EPG	91	
Residual fuel oil	7,100	5,200

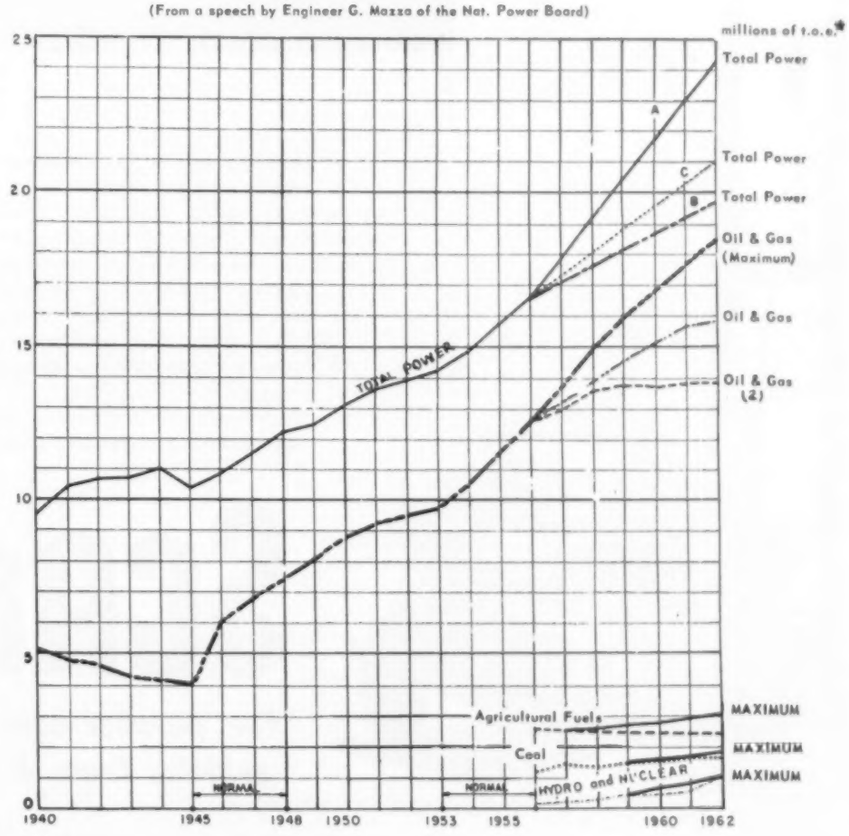
TABLE V
FORECAST OF CHILEAN CONSUMPTION

Liquid Fuels	1960 (Barrels Per Day)	1963 (Barrels Per Day)
Avgas	1,200	1,700
Gasoline	12,500	16,100
Kerosine	5,300	7,600
Diesel oil	8,700	12,600
Residual fuel oil[1]	11,900	18,100

[1] Not including consumption of mining industry, which in 1957 was 691,600 metric tons; approximately 12,400 b/d.

TREND IN FUTURE ENERGY DEMAND

(From a speech by Engineer G. Mazza of the Nat. Power Board)



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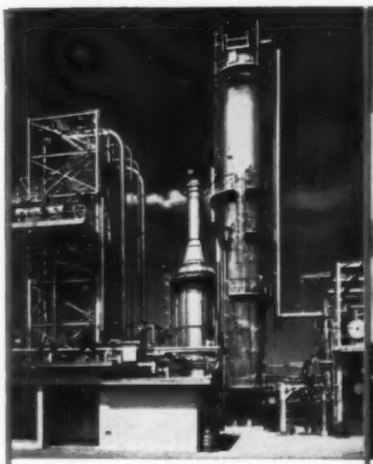
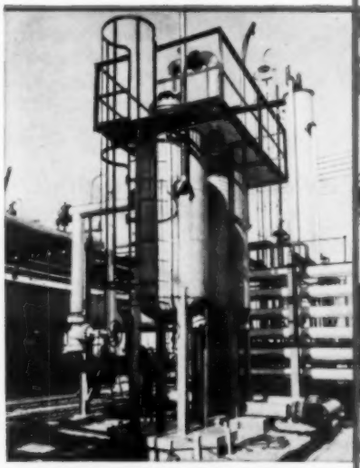
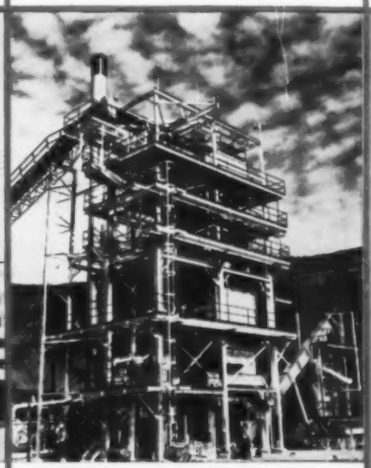


Decarbonizing unit, an exclusive Blaw-Knox development for increasing coking efficiency, lowering costs and improving basic processing procedures.

Alkylation—using sulfuric acid or hydrofluoric acid is one of the many modern intermediate processes supplied by Blaw-Knox.



The world's first Unifining unit, built by Blaw-Knox, improves distillate feed stocks and boosts quality in the product finishing segment of the industry.



This shale retorting plant demonstrates Blaw-Knox leadership in developing future oil sources as well as improving today's processing techniques.

For more information, send for Bulletin 2547, "Petroleum Processing Plants." It describes Blaw-Knox services and reviews results achieved for the industry.

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BLAW-KNOX

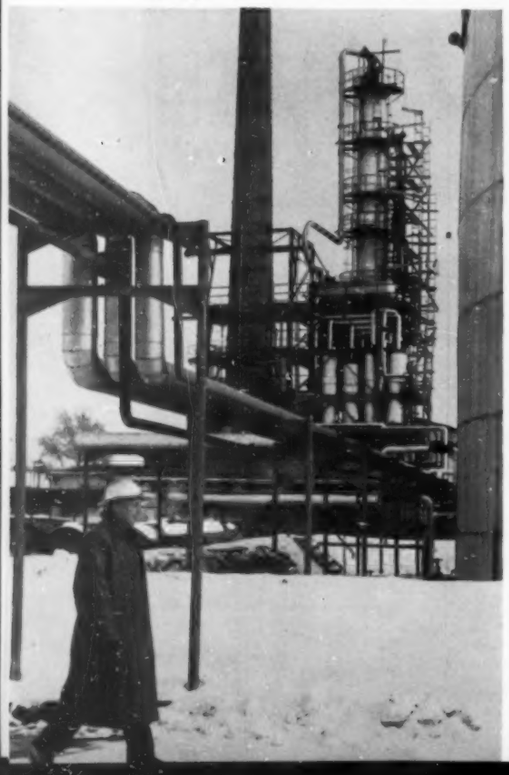
General view of the Greek government refinery at Aspropyrgos, in Attica (photo by courtesy Hydrocarbon Research Inc.).

Refining grows in Austria and Eastern Europe

OeMV has begun construction of a modern new plant to care for expanding consumption and replace plants to be returned to private ownership.

by Rudolf Sobotka

Socony-Vacuum's 215,000-ton-per-year refinery at Kagran.



AUSTRIA

Austria's State-owned company, OeMV, has begun work on the erection of a new 1,600,000-ton-per-year (32,000 b/d) refinery near its present plant at Schwechat. First activity began, April 22.

The new refinery will produce modern high-quality products, and is expected to eliminate the company's current annual loss of some $4 million through a reduction in transportation and fuel costs.

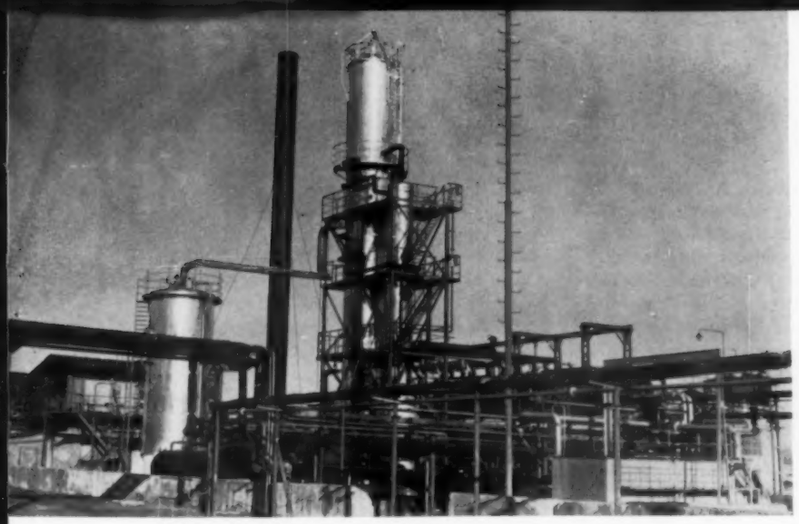
Erection of the new plant is made necessary by growth in demand and the fact that OeMV is supposed to return the 400,000-ton Lobau plant this year to its former owners, Anglo Saxon Petroleum Co. Ltd., and Socony Mobil Oil Co.

When the new plant is completed, it is planned to shut down the old refineries at Voesendorf and Korneuburg.

Capacity of the new plant will equal the expected crude output of Austria during the period 1960-70. By 1965—when Austrian crude reparations deliveries to the USSR will come to an end—Austria will be obliged to import crude, provided no new oil fields have been discovered. The new refinery then will be increased to 2.5 million tons per year. The plant is designed for Austrian and Middle East stock.

At a cost of about $22.4 million, the first construction stage of the new Schwechat plant will save annually about $1.4 million in transportation and $1 million in energy consumption. Over a period of 10 years, a profit of about $60 million is projected.

The refinery is being designed by Iurgi GmbH, Frankfurt am Main. License for the reforming plant was obtained from Universal Oil Products Co. The gas plant will be built by Farbwerke Hoechst, Frankfurt-Hoechst, at an estimated cost of $2.4 million. OeMV will repay this sum by ethylene deliveries to Hoechst's polymerization plant, to be erected nearby. The present contract provides for an annual delivery of 3,700 tons of ethylene. The latter product will be polymerized by Farbwerke Hoechst into polyethylene (Hostalen). This will be the first petrochemical plant in Austria.



OeMV's 300,000-ton-per-year refinery at Korneuburg, built in 1926.

Aerial view of Socony Vacuum's 215,000-ton-per-year refinery at Kagran.

In cooperation with the Italian Montecatini corncern, the Linzer Stickstoffwerke (Nitrogen Works of Linz, Upper Austria) also has announced its intention to begin the erection this year of a petrochemical plant near the Lobau refinery.

Throughput of all Austrian refineries was somewhat greater in 1957 than the year before. According to the statistics of the Ministry of Trade and Reconstruction, 2,038,308 tons of crude (1956: 2,002,253) and 147,896 tons of heavy fuel oil (133,083) were run to refineries.

The major products turned out in 1957 were the following (in metric tons):

AUSTRIAN OIL-PRODUCT OUTPUT
(Metric Tons)

	1957	*1956*
Motor gasoline	241,337	210,609
Special boiling-point gasoline	10,618	8,739
Kerosine	133,804	140,071
Gas oil	547,907	531,242
Fuel oil	1,050,524	1,081,494
Lube oils	66,440	59,329
Bitumen	55,292	34,284
Losses	74,323	69,568
Own consumption	113,158	113,707
Total	2,293,403	2,249,043

TABLE 1

AUSTRIA—OUTPUT OF OeMV's REFINERIES IN 1957 (Metric Tons)

Refineries	Schwechat	Moosbierbaum	Lobau	Korneuburg	Voesendorf	Total
Stock:						
Crude from:						
Zistersdorf	374,708					
Aderklaa	70,758					
Matzen	162,723	312,349	389,965	321,240	78,441	1,710,184
Fuel oil	—	143,482	—	—	—	143,482
Used oil	—	—	210	—	163	373
Other products	124	60	—	124	546	854
Total	608,313	455,891	390,175	321,364	79,150	1,854,893
Products:						
Cracked gas	18,806	22,168	—	—	—	40,974
Gasoline	40,123	15,927	16,714	17,967	3,408	94,139
Cracked gasoline	71,573	70,445	—	—	—	142,018
Special boiling-point gasolines	5,633	—	—	164	—	5,797
Kerosine	56,663	20,594	24,099	17,253	4,484	123,093
Gas oil	163,529	100,371	125,201	65,408	15,916	470,425
Fuel oil—heavy	165,210	189,110	206,510	43,094	4,991	608,915
Fuel oil—medium	11,429	—	—	134,524	10,520	156,473
Fuel oil—light	1,755	—	—	2,064	11,710	15,529
Fuel oil—own consumption	37,231	17,292	11,888	11,376	10,326	88,113
Lube oil—dist.	3,840	—	704	16,709	2,260	23,513
Lube oil—ref.	6,002	—	—	1,281	3,180	10,463
Lubricating grease	—	—	—	—	26	26
Bitumen—soft	3,037	9,958	—	1,916	10,913	25,824
Bitumen—hard	11,277	—	—	5,275	48	16,600
Citogen*	—	—	—	—	7	7
Loss	12,205	10,026	5,059	4,333	1,361	32,984
Total	608,313	455,891	390,175	321,364	79,150	1,854,893

*Trade name of a constituent for printer's ink.

With the exception of kerosine, the consumption of all major petroleum products had increased in 1957 compared with the previous year. It was necessary to import 148,250 tons of gasoline, 198,561 tons of fuel oil, 1,494 tons of gas oil, and 25,674 tons of lube oil and greases. The largest export item was gas oil (269,795 tons), kerosine (10,163 tons), and lube oil and grease (803 tons).

Due to the rising costs of oil production, as well as the necessity of accumulating funds for exploratory drilling, OeMV raised, in January 1958, its price for one ton of crude by about 78¢, to $24.64 from $13.44. The prices of products were not affected.

Negotiations are still in progress between private companies and OeMV as to future operations. Current reports are that Shell and Socony Mobil are suggesting an extension of the proposed syndicated operation to include the new OeMV refinery and the prospective producing area in the Laa region, as well as in Styria and Upper Austria. Agreement seems to be imminent on compensation for crude losses sustained by the private companies by the Matzen area expropriation. OeMV previously had offered the companies a 50-50 ownership deal in Hollabrunn, the southern Vienna basin, in Burgenland, and in areas adjacent to the RAG (Shell-Mobil) present concessions in Lower Austria.

GREECE

Early operation of the Greek government refinery at Aspropyrgos now is anticipated as a result of recent negotiations between government officials and the company organized to take over the plant. The installation has been idle for some months since its completion for the government by Hydrocarbon Research Inc., New York, and associate companies.

Lessee of the plant is expected to be a consortium composed of two Greek businessmen and Socony Mobile Oil Co., which will have a minority interest. Hydrocarbon Research is expected to be in charge of actual operations, and will train Greek nationals to operate the plant with a minimum number of foreign technicians.

The plant itself is one of the largest installations in Europe—with a rated crude capacity of 27,000 b/d (30,000 b/sd). A Catformer, with a capacity of 7,420 b/d, was built for upgrading naphthas to current motor-fuel specifications.

Crude for the plant will be unloaded at a deep-water pier at Megara, where crude storage has been erected. A 22-km 12-in. pipeline has been laid to the refinery. Another pier, adjacent to the refinery, will be used for loading products into smaller tankers and barges. Four- and five-inch product lines have been laid to Piraeus to facilitate distribution. Tankage has been provided for a 28-day crude supply and a 20-day output of products.

The new refinery will supply a large part of the nation's requirements for petroleum products. Imports in 1956 averaged 32,000 b/d, at an annual cost of $45.6 million. Refining more than 80% of Greek oil requirements in the country should permit a substantial saving in foreign exchange.

OIL PROCESSING IN SOVIET AREAS

The development of the refining industry in the Soviet bloc is characterized by the tendency among the satellite countries to refine indigenous crude within the country rather than exporting it (e.g., Albania, Bulgaria), and to replace the import of products from the USSR by crude deliveries (e.g., Czechoslovakia, Poland, Hungary).

Albania produced, in 1957, 489,765 tons of crude and refined 21,328 tons of gasoline, 38,209 tons of gas oil, 146,938 tons of liquid asphalt, and 24,314 tons of refined asphalt. The export of petroleum and products, estimated at over 300,000 tons in 1957, occupied first place in the foreign trade.

A 150,000-ton-per-year distillation plant went onstream at Stalin, March 17, 1957. The oil refinery at Cerrik of the same capacity, built by Soviet credits, was given to Albania in April 1957 due to difficulties on the part of Albania in repaying the Soviet credit.

Bulgaria produced 285,000 tons of crude. The consumption of oil products in 1957 was estimated at 700,000 tons; it is expected to rise to 900,000 by 1962. Therefore, the construction during the third 5-year plan (1958-62) of a vacuum distillation unit at Russe is recommended in order to halt the export of crude oil for lack of processing facilities. By the sale of products, Bulgaria expects to obtain a 40% higher price than for its crude oil.

There are two distillation plants of undisclosed capacity at Russe. An asphalt plant is under construction there. Its capacity is to be doubled in 1959, to 40,000 tons per year.

The Soviet Union delivered to Bulgaria 378,700 tons of products.

Czechoslovakia produced approximately 105,000 tons of crude (no official figure available), of which 63,000 tons were produced in Slovakia. A disproportionate rise in the consumption of diesel fuel caused a bottleneck which is to be removed by again producing trucks running on gasoline.

The distillation unit of a new oil refinery, under construction at Vlci Hrdlo, near Bratislava, went onstream, July 27, 1957. The plant processes Soviet crude. By 1965—in which year the refinery is scheduled for final completion—it is said crude imports from the USSR will be three times the volume of 1957, which was 85% of the total crude import of 792,000 tons. This would mean an increase in refining capacities of more than two million tons per year by 1965.

Hungary produced only 672,000 tons of crude in 1957, compared with 1.6 million tons in 1955; but refinery runs rose to a new peak of 1.7 million tons.

Oil and gas were sufficient for only 11.4% of the energy requirement in 1957. Imports amounted to 1,001,911 tons of crude, 39,360 tons of gas oil, and 146,481 tons of fuel oil.

There are refineries at Almasfuezitoe, Csepel, Szoeny, Petfuerdoe, and Zalaegerszeg.

Poland produced 180,600 tons of crude. The output of natural gasoline was 16,120 tons. The throughput capacity of the refineries at Czechowice, Glinik-Mariampolski, Jaslo, Jedlicze, and Trzebinia was said to be 760,000 tons in 1957. The crude production covered only 10% of the 1.8 million tons of products consumed. For 1960, a consumption of 2.7 million tons is expected.

To meet the growing demand, a refinery is to be constructed with Soviet aid at Konin, with an initial capacity of two million tons per year. The year of completion is probably 1963, and Poland will then receive from the Soviet Union chiefly crude.

In 1957, the USSR covered Poland's requirement for crude by 100%, and products by 55%. In 1958, the ratio will be 100% and 82%, respectively.

The refineries had a turnover of 640 million zloty ($160 million,) against 563 million zloty ($140 million) in 1956. Completed in 1957 was a 3,600-ton-per-year furfural extraction plant and an 18,000-ton-per-year asphalt plant at the Jedlicze refinery, and a 50,000-ton-per-year primary distillation plant at Trzebinia.

Romania produced somewhat more than 11 million tons of crude. The throughput capacity of the refineries is keeping pace with the country's crude-oil output.

Completed in 1957 were: the No. 1 thermal cracking plant and the No. 2 distillation unit at the Borzesti refinery, and 156 miles of oil and gas pipelines.

Under construction are an atmospheric distillation plant and a dewaxing unit of the second processing line at the Teleajen refinery.

Near the Brazi refinery, the No. 2 petroleum chemical works are under construction, which will turn out methylethylketone and acetone. The former product will be used for the dewaxing of oil.

The *Soviet Union* produced 98.3 million tons of crude. About three million tons of crude and products were exported to the satellite countries. The exports from the Soviet Black Sea ports were estimated at six million tons.

In February 1958, the new refinery at Stalingrad went on stream. With this refinery, the "Second Baku" area contains more than 50% of the nation's refining capacity, against 10% in 1940. The share of the old Baku area is now only 33%, against 84% in 1940. The center of refining is constantly moving eastward.

During the next 15 years, the USSR intends to invest in the oil industry $45 billion. During this period, the present crude output is to be increased by three to four times. At the same time, refineries with a total capacity of 300 million tons per year are to be erected. The capacity of the individual plants is to be not less than six million tons per year.

During the next 10 years, the refineries will turn out chiefly diesel fuel. The production of jet fuel will also rise rapidly. New plants for plastics and for synthetic fibers and rubber are to be built on petroleum and coke basis.

Yugoslavia: Ambitious plans have been made for expanding refinery capacity in Yugoslavia within the next four years. Current crude charging capacity of the nation's three plants is 22,700 b/d. It is anticipated that a fourth plant will be built, and other plants enlarged, to an aggregate capacity of 56,000 b/d by 1962.

First project is enlargement by 1960 to 12,400 b/d of the Sisak plant from its present 8,800 b/d. In the following two years a new plant is to be built at an undisclosed location with a capacity of 21,900 b/d; the Bosanski plant doubled to 13,200 b/d; and the Rijeka plant increased to 8,500 b/d from 7,300 b/d.

Cracking capacity of the Sisak plant is now 4,000 b/d, and at Bosanski Brod 2,400 b/d. The new plant will have a 10,000 b/d cat cracker.

Crude runs of three existing refineries in 1957 averaged 20,700 b/d—an increase of 16.5% over 1956. Output of gasoline in the year totaled 1,932,000 bbl; kerosine, 575,000 bbl; gas oil, 1,833,000 bbl; fuel oil, 2,325,000 bbl; lubes, 276,000 bbl; and other products, 511,000 bbl.

Yugoslav fields produced 2,883,000 bbl in 1957, and imports totaled 4,726,000 bbl.

END

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Pipelines on the Hydrocarbon Fractionation Unit, at the new Shell Chemical Plant, Stanlow, near Chester, England. (A Shell photograph).

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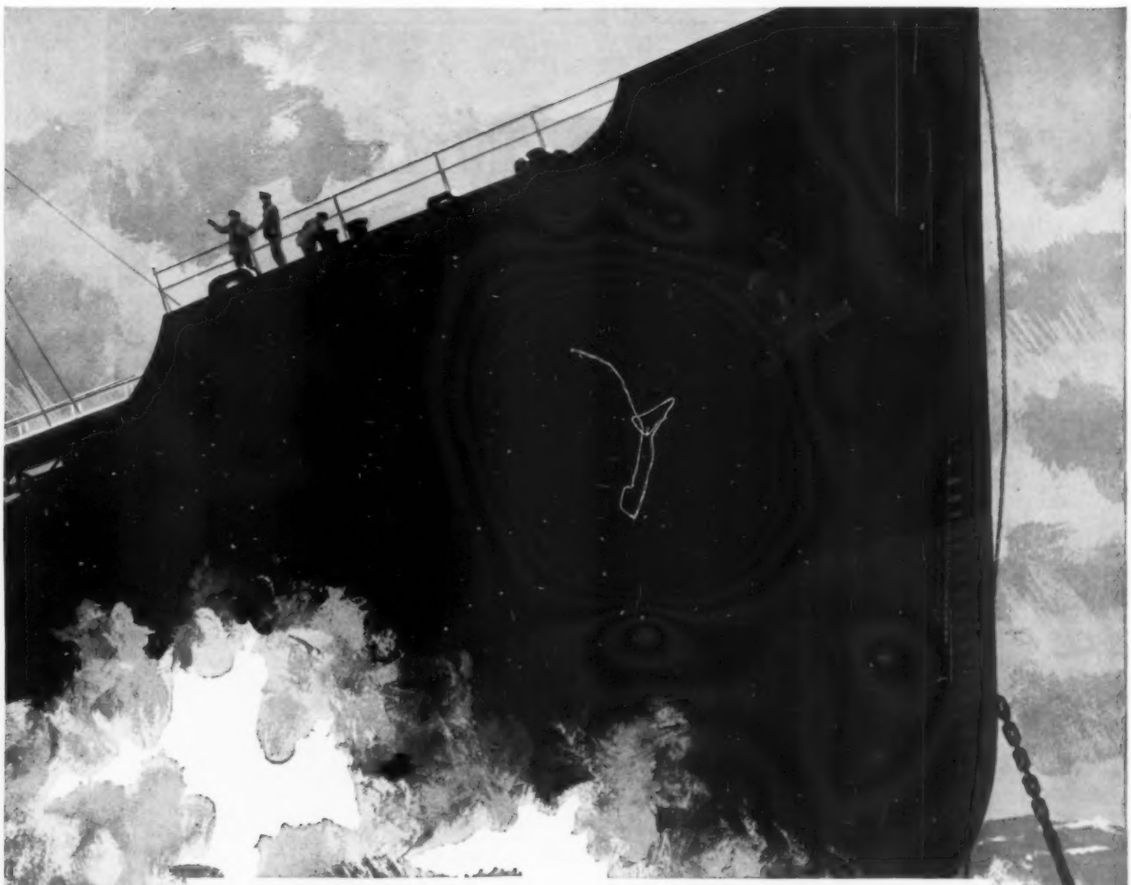

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MATTHEW HALL & CO. LIMITED

CHAIRMAN'S STATEMENT

The Thirty-first Annual General Meeting of Matthew Hall & Co. Limited was held on 4th June, 1958, at Matthew Hall House, Dorset Square, London.

The following is an extract from the circulated statement of the Chairman, Mr. Bertram Baden, M.C., S.B.St.J., M.I.H.V.E.

I am happy to report a consolidated trading profit for 1957 of £321,854 (1956—£314,-739), despite a reduction in the trading profit of our South African subsidiary company due to the keen competition I mentioned last year.

The group net profit after all charges, including taxation, was £99,319 (1956—£107,376). £60,500 has been transferred to general reserve and the directors recommend a dividend of 30% (1956—30%) to be paid by the parent company, and the capitalisation of £60,000 of the company's reserves to be applied in paying up in full 240,000 new ordinary shares of 5/-d. each to be issued to members in the proportion of one new share for every three shares already held. Next year it is hoped to maintain the present rate of dividend (30%) on the new capital.

The directors also propose that of the £10,500 of accumulated profits transferred to capital reserve, £9,900 be distributed as a dividend of 5½%, free of income tax.

NUCLEAR ENERGY DIVISION

During the year your company received orders for the installation of graphite moderators, instrumentation, fission product detection involving over 250 miles of stainless steel pipework, and other work at the new Central Electricity Generating Board nuclear power stations.

Our work at Calder Hall power station and other atomic research stations still continues.

CHEMICAL, OIL REFINERY AND INDUSTRIAL ENGINEERING DIVISIONS

The design, procurement and construction of a number of new chemical plants were among projects undertaken by these divisions.

Other contracts included the erection of a 55,000 tons per annum paper making machine which will be one of the largest in the world.

Our work at the oil refineries continued.

AUTOMATIC SPRINKLERS AND FIRE PROTECTION

During the year we received orders for office blocks, factories, theatres, power stations, garages and warehouses at home and overseas.

MATTHEW HALL (PTY.) LTD., SOUTH AFRICA

Contracts included plants for desalting mine water, oil blending and insecticides. This company continued to install air conditioning, automatic sprinklers and fire protection, plumbing and electrical services to major buildings.

The report and accounts were adopted.

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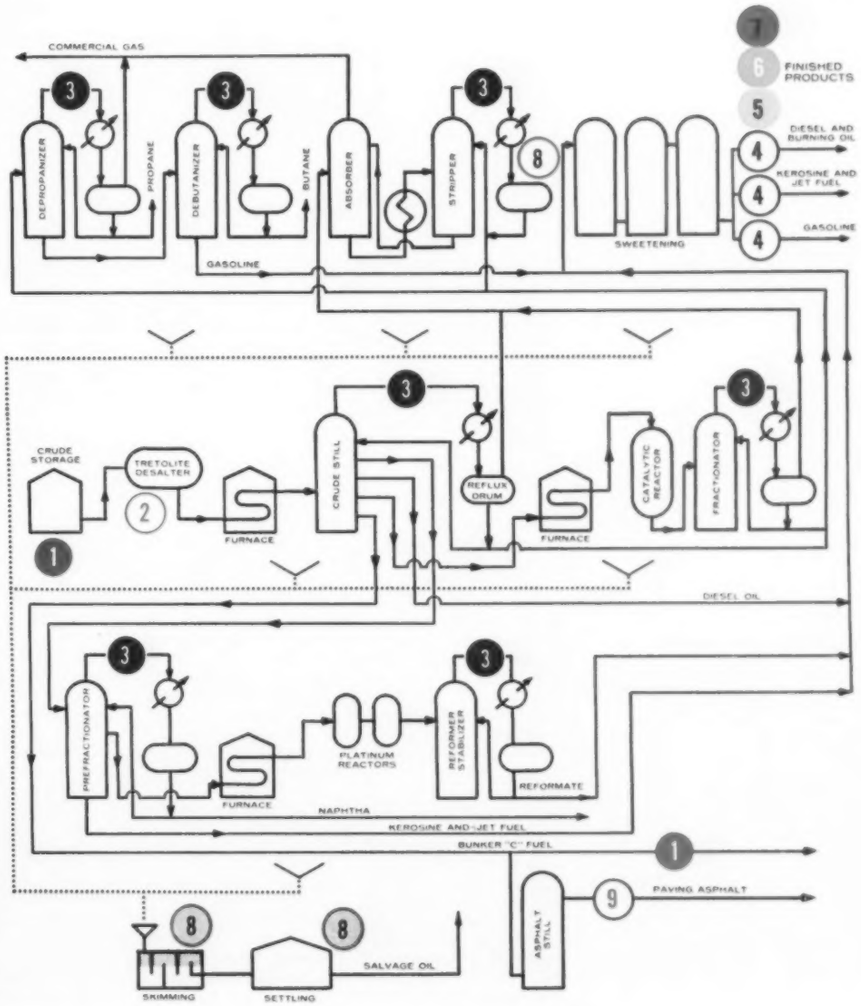

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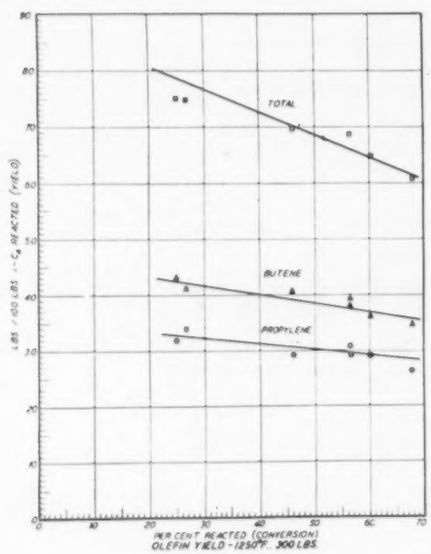
AR-58-2

Annual review of USA patents on petroleum refining and processing

Patents related to refining and processing technology have been along established lines during the past year—with no important new breakthroughs. Improvements and modifications have predominated—with emphasis on high-octane gasoline and sharp increase in alkylation patents.

by Heinz Heinemann and Harold Shalit

USA Patent 2,816,150, dated December 10, 1957, to H. J. Hepp: "Conversion of isobutane to propylene and butylene for alkylation with isobutane."



In the several years, during which this review has appeared annually in the "Annual Refinery Issue" of *World Petroleum*, the number of USA patents pertaining to the technology of petroleum refining and processing has increased from year to year. In 1957, it was necessary to consider 400 patents after two reviews on specific phases had appeared earlier in the year. This year a review of cracking patents appeared in the January 1958 issue and one on refining patents in the May 1958 issue. Nevertheless, there remained 460 patents which had not previously been considered. Of those, 94 have been selected for treatment in this review as characteristic of new developments and trends.

No new breakthroughs of major importance have occurred during the year, and the subjects of invention are mostly along established lines. Process improvements and modifications rather than radically new concepts characterize this year's petroleum refining patents. There still is major emphasis on the production of high-octane gasolines. Auxiliary processes, such as desulfurization and metals removal have had a good share of attention. The number of new patents on alkylation has increased sharply, reflecting probably the fact that alkylate is rapidly becoming an important high octane ingredient of motor gasoline. The number of reforming patents has dropped. Otherwise, there has been little change in the ratio of patents issued in various areas.

Isomerization: The number of new isomerization patents is quite small and has not increased proportionally, even though paraffin isomerization is receiving much attention. This may mean that the art is well covered by precious metal reforming patents or that work along these lines has been too recent to result in many issued patents.

N. C. Carter and J. S. Cromeans (2,747,004 to Phillips Petroleum Co.) hydroisomerize paraffins over molybdenum oxide-silica-alumina catalysts after removing all carbon oxides from the hydrogen used. In Houdry Process Corporation's 2,798,105 H. Heinemann and G. A. Mills disclose a method of isomerizing C_4 and C_5 aliphatic paraffins over a platinum-alumina catalyst in the presence of 0.001-0.5% HCl (based on feed) and of 0.1-40 moles of hydrogen per mole of feed.

Olefinic hydrocarbons can be isomerized to products with a more centrally located double bond according to H. Pines and V. N. Ipatieff (2,804,489 to Universal Oil Products Co.). An alkali metal catalyst is used in the presence of a halogen substituted hydrocarbon promoter, such as ochlorotoluene. J. W. Myers (2,818,451 to Phillips Petroleum Co.) isomerizes xylenes and other poly alkyl benzenes over a catalyst comprising manganese oxide, admixed with at least one member of the group consisting of silica, alumina, zirconia, magnesia, beryllia, titania and HF treated alumina.

Alkylation and Related Processes: A number of new catalysts have been proposed for the alklyation of paraffins and olefins. According to E. F. Peters and B. L. Evering (2,820,835 to Standard Oil Co. of Indiana) this reaction is carried out at 150-210° F. and 50-2000 p.s.i.g. over a catalyst comprising 1-10% cobalt oxide, 2-15% molybdenum oxide and 2-20% HF, with the remainder consisting essentially of alumina. H. R. Appell in Universal Oil Products Company's 2,818,392 claims a catalyst comprising a siliceous or carbonaceous support, impregnated with an aqueous solution of phosphoric acid. The composite is dried at 100-600° C. and subsequently impregnated with boron trifluoride.

A process for the alkylation of iso-paraffin with olefin in the presence of hydrogen fluoride with maximum utilization and minimum loss of low boiling iso-paraffin is the subject of U.O.P.'s patent 2,818,459 (J. E. Gantt). H. Pines according to another U.O.P. patent (2,820,074) produces alkylate from normal-butane, iso-butane and butene-1 by reacting HCl with the butene-1, separating butychloride, dehydrohalogenating butylchloride to obtain butene-2, and alkylating butene-2 with the iso-butane. Details of an alkylation procedure are disclosed in Phillips Petroleum Company's 2,820,073 (R. E. Dixon and C. C. Chapman).

A large number of patents assigned to the American Oil Co. (2,824,150—2,824,163; H. M. Knight and

(Continued on page 126)

"...the oil industry expanded very rapidly since World War II, and like other industries it is undergoing adjustment and reappraisal. However, nothing in the long-term outlook has diminished our confidence in an expanding future for our industry. The need for our products will grow steadily, and our problems lie in the direction of meeting those needs through the most efficient use of capital and at the lowest possible cost of operations, and not in losing our long-range perspective because of a temporary recession."

—M. J. Rathbone, President, Standard Oil Company (New Jersey)

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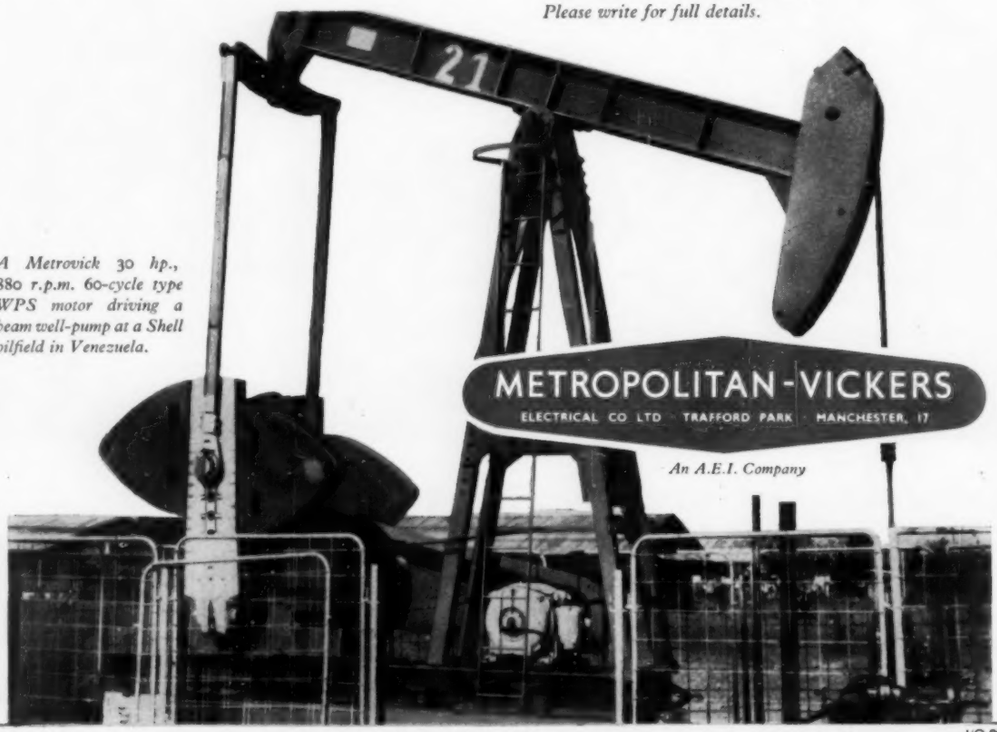
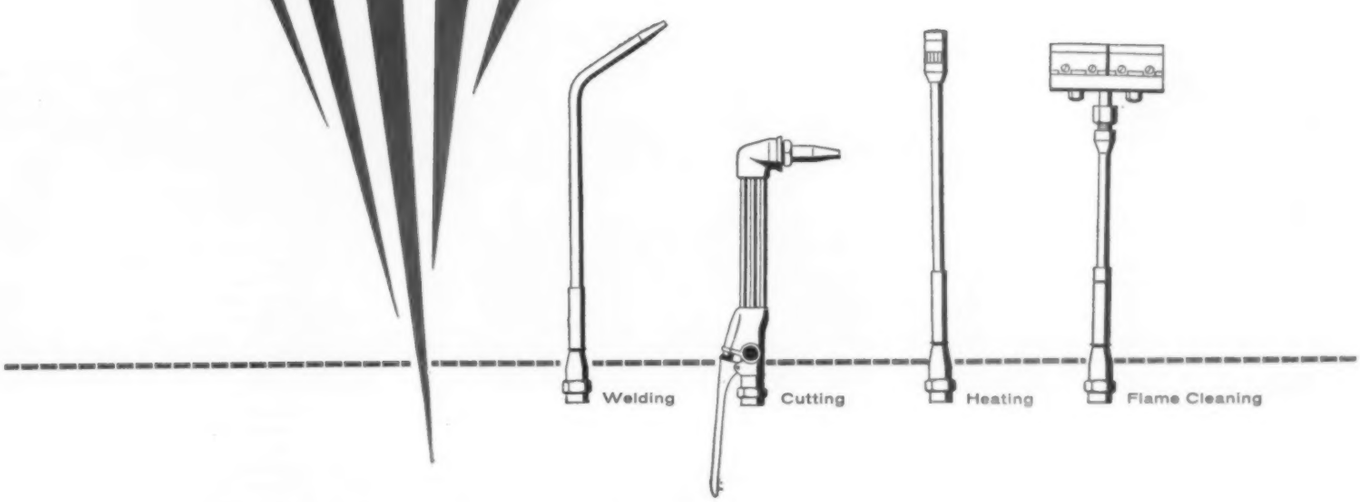


A Metrovick 30 hp., 880 r.p.m. 60-cycle type WPS motor driving a beam well-pump at a Shell oilfield in Venezuela.

J/O-801

FROM BRITISH OXYGEN—FOR BRITISH INDUSTRY



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Annual Review of USA patents on Petroleum Refining and Processing

(Continued from page 122)

J. T. Kelly) describes the alkylation of iso-paraffins or aromatics with olefins over a catalyst pair comprising boron trifluoride and a metal sulfate hydrate, such as cadmium sulfate, cerium sulfate, beryllium sulfate and magnesium sulfate at 25-40° C.

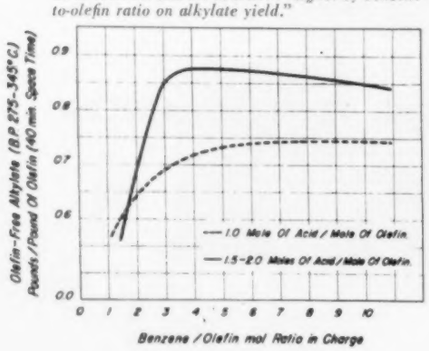
H. J. Hepp in Phillips Petroleum Company's 2,816,150 discusses an integrated cracking-alkylation process, in which iso-butane is converted to propylene and butylene, which are then in turn alkylated with the remaining i-butane (see accompanying illustration).

A considerable number of patents covers the alkylation of aromatics. H. C. Brown and W. S. Higley (2,767,230 to Standard Oil Co. of Indiana) propose the use of phosphorus pentafluoride as a catalyst. D. A. McCaulay and A. P. Lien in two other Standard Oil Co. of Indiana patents (2,803,682 and 2,803,683) prepare ethylxylenes by alkylation of xylenes with olefins in the presence of $HF\text{-}BF_3$. R. Landau according to Mid-Century Corporation's 2,814,652 produces tri-isopropyl benzene from benzene and propylene in the presence of tetra and higher propylated benzenes and an acid reacting alkylation catalyst. Universal Oil Products Company's 2,821,562 (G. L. Hervert and H. S. Bloch) discusses the alkylation of benzene with olefin in the presence of sulfuric acid. Mole ratios of benzene to olefin of between 3:1 and 15:1 are maintained and fresh acid of at least 95% concentration is continuously introduced. (See accompanying graph.) C. C. King (2,787,648 to The M. W. Kellogg Co.) separates unreacted aromatics from an alkylation zone effluent and removes contaminants prior to recycling the aromatics.

The alkylation of phenolic compounds is discussed by G. F. d'Alelio (2,802,884 to Koppers Co.). Cation exchange resins, containing sulfonic acid groups are employed as catalysts. E. Field and M. Feller (2,823,-240 to Standard Oil Co. of Indiana) disclose a method to produce an indane hydrocarbon from an alkyl aromatic and ethylene in the presence of alkali metal hydride and alkali metal aluminum hydride at 160-350° and 200 p.s.i.g.

Two Standard Oil Co. of Indiana patents deal with alkyl group transfer. A. P. Lien and D. A. McCaulay in 2,795,630 synthesize 1, 3, 5 trialkyl benzene by group transfer in the presence of $HF\text{-}BF_3$. McCaulay in 2,814,651 prepares tetra methyl benzene from trimethyl benzene and diethyl benzene in the presence of HF at 100-150° C. E. R. Boedecker according to a Houdry Process Corp. patent (2,795,-629) converts toluene to benzene and xylene over a silica-alumina catalyst at 850-1150° F. and at 200-600 p.s.i.g.

USA Patent 2,821,562, dated January 28, 1958, to G. L. Hervert and H. S. Bloch: "Effect of benzene-to-olefin ratio on alkylate yield."


Olefin-Free Alkylate (B.P. 275-345°C.) Pounds/Pound Of Olefin (40 min. Space Time)
0.9
0.8
0.7
0.6
0.0
0 1 2 3 4 5 6 7 8 9 10
Benzene / Olefin mol Ratio in Charge
— 1.0 Mole Of Acid / Mole Of Olefin
— 1.5-2.0 Moles Of Acid / Mole Of Olefin

Desulfurization: This remains an active field. While major emphasis continues on hydrodesulfurization as a feed preparation for catalytic reforming and means to improve distillate fuels, it is notable that new and improved sweetening procedures also appear continuously in the patent literature.

Three British Petroleum Co. patents deal with hydrodesulfurization processes. F. W. B. Porter and R. P. Northcutt (2,800,430) describe the autofining of naphthas under equilibrium conditions. The pressure rises to a maximum within 5-25 hours and then falls gradually with decreasing dehydrogenation activity of the catalyst. Increased life may be obtained by maintaining the autofining equilibrium pressure by means of external hydrogen. Porter, D. A. Howes and J. E. Morris in 2,800,429 carry out an autofining reaction, in which all hydrogen produced is allowed to remain in the system. The catalyst is cobalt molybdena on alumina on a bauxite and contains 0.1-6% fluorine (see accompanying illustration). In 2,769,758 Porter and J. S. Isitt hydrodesulfurize feed stocks contaiinng vanadium and/or sodium by contacting the feed with bauxite at elevated temperature and pressure prior to hydrofining.

A Union Oil Co. of California patent (2,793,170, V. E. Stiles and T. V. Inwood) discusses the hydrodesulfurization of cracked gasolines without substantial hydrogenation of olefins. A cobalt molybdena alumina catalyst is used, which is partially deactivated by the presence of 0.2-6% of catalytic carbon intimately associated with the active surface of the catalyst. Two Gulf Res. & Dev. Co. patents describe hydrodesulfurization processes. V. J. Anhorn in 2,791,546 proposes a fluidized bed technique for materials containing residual components. W. C. Offutt's 2,794,766 concerns a liquid phase process and a catalyst regeneration system.

Sweetening by means of finely divided, supported metallic silver is disclosed by C. N. Kimberlin and R. B. Mason in Esso Res. & Eng. Co.'s 2,791,540. According to the same Company's 2,776,929 (B. M. Vanderbilt) mixtures of sodium hydroxide and isopropyl alcohol are used for sweetening after having been subjected to an azeotropic distillation. C. A. Porter and M. E. Marks (2,753,292 to The Pure Oil Co.) discuss a method of treating hydrocarbons with alkaline reagents.

Sweetening with an organic compound of a group VIII metal, having at least one chelate bond and formed from an iminophenol is carried out in the presence of oxygen according to A. Gislon and J. M. Quinquerez (2,823,173 to Co. Francaise de Raffinage). W. H. Dennis (2,793,985 to Phillips Petroleum Co.) sweetens with a copper compound containing bed of clay which has incorporated a polyelectrolite to prevent compacting due to moisture.

Mercaptans and organic peroxides in a naphtha can be reacted in the presence of an aqueous alkali solution containing less than 0.003% of a catalyst from the group consisting of lead, bismuth and thallium (2,798,842; L. D. Rampino to Tidewater Oil Co.). A mixture of 70 vol. % of a polyethylene glycol and 30% isopropyl alcohol is proposed by L. E. Hutchings (2,792,332 to the Pure Oil Co.) as a solvent for the removal of aromatic type sulfur compounds from kerosine or diesel oil. G. W. Ayers of the same Company (2,793,983) treats sweetened naphthas, containing small amounts of disulfides with a thiophenol.

Refining: Most of the very large number of patents, which have been issued during the year on separation and treating tchniqeus were treated in the special review of the subject in the May, 1958 issue of World Petroleum.

Cracking and Coking: Although patents in these areas were discussed in the January, 1958 issue of *World Petroleum*, enough new work has been published to bring a supplementary survey at this time. It is interesting to note that the production of olefins and acetylenes by hydrocarbon cracking has assumed considerable importance in the recent patent literature.

Two typical patents in the area of cracking feed preparation are D. C. Hansch's 2,809,923 (to Shell Dev. Co.) and C. E. Jahnig and A. F. Kaulakis' 2,825,678 (to Esso Res. & Eng. Co.). Hansch separates a cat. cracking feed stock from petroleum resides by a vacuum flashing process. Jahnig and Kaulakis purify water and oil insoluble iron rich contaminant containing gas oils by intimate mixing with 5-10% water and settling for 5-100 hours.

Apparatus for cracking is described in several patents. Means for continuous evaporation and cracking are disclosed by J. Geller in 2,758,061 (to Rutgerswerke A.G.). Vapor phase cracking of hydrocarbons in a moving bed is the subject of F. Schaub in Ruhrchemie A.G.'s 2,817,625, while J. B. Willis and T. H. Paulsen (2,819,203 to Sinclair Refining Co.) discuss a method of thermally cracking catalytic cycle gas oil. E. O. Boston (2,813,916 to Esso Res. & Eng. Co.) cracks and cokes a heavy hydrocarbon feed in a high temperature fluidized bed apparatus with several stages at progressively higher temperatures.

The production of olefin rich products from high boiling hydrocarbons, containing less than 25% aromatics is discussed in Shell Dev. Co.'s 2,824,148 (A.I.M. Keulemans and A. Kwantes). Cracking occurs at at least 500° C. and the feed is rapidly brought to this temperature by completely burning part of it in the presence of an oxidation catalyst.

Acetylene and synthesis gas can be prepared from normally gaseous hydrocarbons according to F. G. Pearce's 2,813,919 (to Pan American Petroleum Co.). W. E. Lobo (2,817,690 to The M. W. Kellogg Co.) produces acetylene from methane and oxygen. The combustion flame is maintaind within the conversion zone by contacting the reactants therein with a flame stabilizing material having strong oxidizing properties, such as platinum or fused alumina. A process and apparatus for pyrolysing a hydrocarbon gas to acetylene is disclosed by S. P. Robinson in Phillips Petroleum Co.'s 2,823,243. A combustion gas is formed by burning hydrogen and oxygen at 4500-5300° F. and blending this gas with preheated gaseous hydrocarbons.

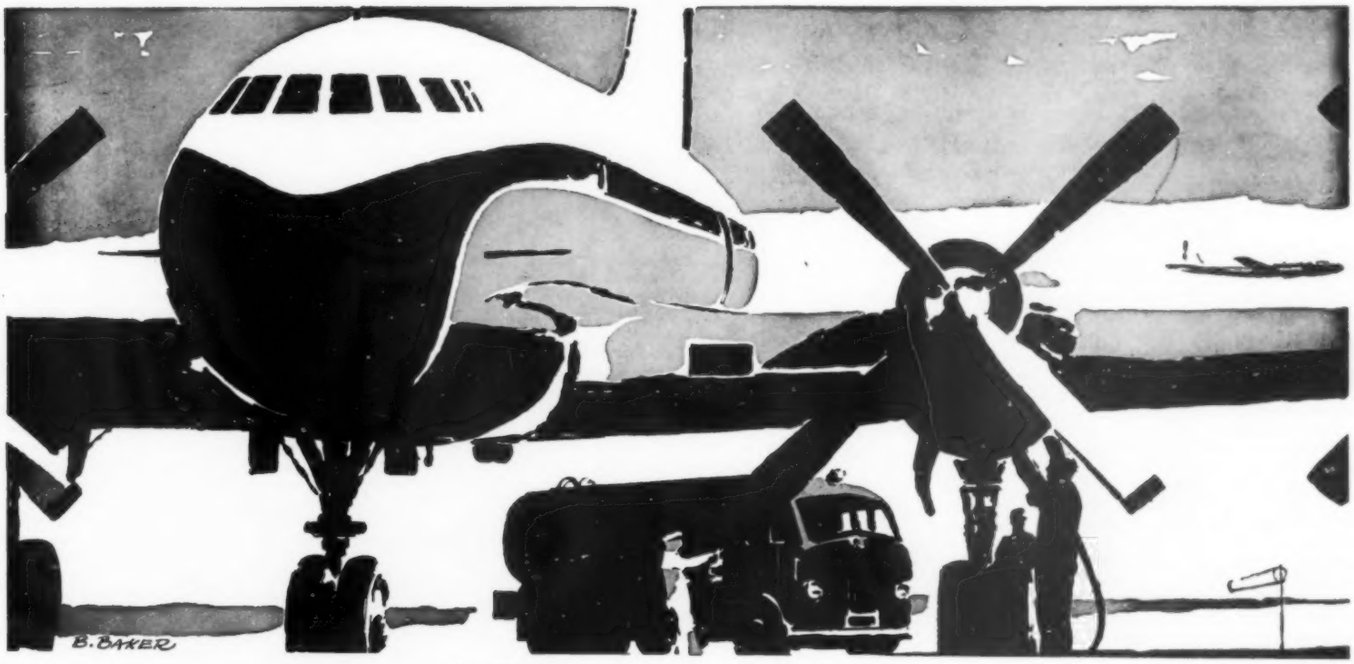
Two typical coking patents are: 2,813,824 (E. Gorin to Pittsburgh Consolidation Coal Co.), according to which an ash containing hydrocarbonaceous liquid is first coked mildly and the ash-free vapors are then coked severely to give a low-ash coke; 2,819,204 (H. Z. Martin to Esso Res. & Eng. Co.), which proposes to devolatilize and desulfurize fluid coke by heating it to at least 2200° F. in countercurrent contact with gravitating hot pebbles.

REFORMING, HYDROCARBON, AND DEHYDROGENATION

a. *Reforming*—Catalytic reforming has rapidly become a major and established refining process. For a few years the major effort made by many companies to obtain a foothold in this field resulted in a very large number of patents issuing. This year, the patents in this area are still numerous, but fewer than before, probably indicating that the field has been extensively covered. Reforming catalyst patents will be discussed in the section on catalysts.

An apparatus for reforming hydrocarbons in a moving bed unit is proposed in 2,809,922 (C. H. O. Berg, R. P. Vaell and J. H. Ballard to Union Oil Co. of Cal.). Three patents assigned to The M. W. Kellogg Co. deal with reforming processes. H. G. McGrath and M. R. Smith in 2,787,583 describe a non-regenerative fluid hydroforming procedure, while M. F. Nathan (2,791,542) discloses a fluidized technique with a platinum catalyst, involving a number of stripping and regeneration steps. C. E. Slyngstad in 2,799,624 hydroforms light hydrocarbon oils in the presence of finely divided phospho molybdic acid on alumina at 930° F. and 250 p.s.i.g. Methods of reforming in a static bed are described by W. P. Evans in 2,791,543 (to Socony Mobil Oil Co.).

(Continued on page 128)



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*Comox is the registered trade mark for Spence cobalt and molybdenum oxides on alumina catalyst.

E. W. S. Nicholson and A. Voorhies (2,808,366 to Esso Res. & Eng. Co.) discuss a fluidized hydroforming process, in which freshly regenerated catalyst is first contacted with low sulfur feed and then with high sulfur feed, prior to regeneration. A fluid batch process, utilizing a noble metal catalyst is the subject to Esso's patent 2,805,980 (D. D. MacLaren). W. E. Askey (2,804,426 to Esso Res. & Eng. Co.) hydroforms naphthenic naphthas with molybdena-alumina in a fixed bed. Catalyst is periodically withdrawn and material with a bulk density of less than 60 lbs./cft. is discarded.

A two stage desulfurization-hydroforming process is described by F. W. B. Porter and A. H. Richardson (2,792,333 to British Petroleum Co.). Hydrogen produced in one stage is used for desulfurizing hydrocarbon feed in the other stage. Production of aromatics is discussed in two patents. R. G. Hay and R. W. Helwig (2,794,841 to Gulf Res. & Dev. Co.) disclose a fluidized process for the separation of aromatics and their separation from entrained catalyst fines and reaction products of lower boiling point. K. Nozaki (2,818,939 to Shell Dev. Co.) dehydroisomerizes C_5 ring naphthenes over a catalyst comprising silica gel of at least 300 m^2/g. promoted with 0.1-0.8% alumina and 0.1%-1% platinum.

The regeneration of platinum containing catalysts in fixed bed operation is according to W. F. Engel (2,792,337 to Shell Dev. Co.) carried out reliably and reproducibly by introducing oxygen containing gas into the catalyst bed without prior contact of the gas with parts of the converter and the feed inlet line.

The oxidative reforming of naphtha in the absence of an oxygen containing gas is the subject of Standard Oil Co. of Ohio's 2,783,185 (E. C. Hughes, H. A. Strecker and A. W. Jones). Conversion is over a catalyst comprising arsenic pentoxide or antimony pentoxide after the reaction.

b. *Dehydrogenation:* S. G. Hindin (2,790,015 to Houdry Process Corp.) describes the dehydrogenation of hydrocarbons with a substantially anhydrous feed over a specially prepared and dried y-alumina, containing some, but less than 0.2% water. D. W. Wood, H. S. Maisel and J. C. Hunt (2,820,072 to Esso Res. & Eng. Co.) dehydrogenate hydrocarbons by passing catalyst and suspending reaction vapors upwards through a reaction zone and quenching with a more readily dehydrogenable hydrocarbon. V. I. Komarewsky (2,820,834 to Heavy Minerals Co.) dehydrogenates aliphatic C_2-C_5 hydrocarbons over samarium sesquioxide at 430-650° F.

Butadiene production is discussed in three patents. J. W. Delaplaine (2,816,943 to Catalytic Construction Co.) separates the reactor effluent of a butane dehydrogenation unit by means of extractive distillation with a paraffin oil, boiling between 155-345° F. Another separation procedure is disclosed in Phillips Petroleum Co.'s 2,813,141 (C. H. Mathis, F. A. Siedenstrang and W. W. Vandiver). Butylene to butadiene dehydrogenation is the subject of W. R. Doenkle (2,804,487 to Shell Dev. Co.).

c. *Hydrogenation:* A process for the selective hydrogenation of acetylene in the presence of ethylene is proposed in Dow Chemical Co.'s 2,802,889 (C. L. K. Frevel, and L. J. Kressley). The catalyst comprises 60-99 wt.% palladium and 40-1% of an element consisting of copper, silver or gold. R. J. Hogan and L. E. Gardner (2,814,653 to Phillips Petroleum Co.) remove acetylene from hydrocarbon mixtures by first hydrogenating at mild conditions and then subjecting the product to hydrogenation-polymerization at relatively high temperatures.

A fluidized bed hydrocracking process is described in The M. W. Kellogg Co.'s 2,799,626 (W. B. Johnson and E. A. Weinman). Hydrogenation of the pentene fraction of a naphtha greatly improves the anti-knock rating of cracked naphthas according to Esso's 2,810,004 (R. C. Morback and R. J. Lang). A process for producing hydrogen from hydrocarbons is disclosed by A. C. Faatz, Jr. in 2,813,779 (to Foster-Wheeler Corp.).

Catalysts: Patents on catalyst composition are, of course, closely related to process patents, involving the use of specific catalysts. The number of patents describing new petroleum refining catalysts or methods of their preparation, continues to be very large and only a few can be discussed here. It is notable, that there are very few new cracking or alkylation catalyst patents and that the emphasis in hydrogenation-reforming catalyst patents has shifted from platinum to molybdena containing catalysts.

The preparation of an alumina gel is disclosed by E. M. Gladrow and W. F. Arey in Esso Res. & Eng. Co.'s 2,798,050.

L. C. Mabry, Jr. and J. W. Myers (2,817,626 to Phillips Petroleum Co.) activate a hydrocracking catalyst comprising iron oxide and at least one metal oxide of the group of molybdenum, chromium, tungsten and vanadium by heating in a hydrogen containing ambient, free of catalyst poisons at a temperature above 1200° F. and below that at which catalyst deterioration occurs. Hydroforming catalysts according to J. A. Polack (2,882,336 to Esso Res. & Eng. Co.) are prepared by intimately mixing zinc oxide, alumina and molybdena in dry, finely divided state and calcining the mixture at 1100-1400° F. for from 3 to 16 hours. Two British Petroleum Co. patents describe hydrodesulfurization catalysts. A cobalt molybdena containing fluorine is prepared according to R. P. Northcutt and E. C. Housam (2,793,984) by reacting cobalt-molybdena with benzotrifluoride at above 500° F. F. W. B. Porter and L. B. Witten (2,817,637) add cobalt, molybdenum and fluorine compounds to wet alumina gel, which is then dried and roasted. R. P. Sieg (2,824,024 to California Research Corp.) describes a fluid catalyst of increased attrition resistance and process life which contains alumina, molybdena and from 0.5-15% of crystalline graphite particles. A. Clark (2,814,650 to Phillips Petroleum Co.) activates molybdena catalysts to treatment with a hydrogen containing ambient and an ammonia containing ambient at 950-1300° F. P. A. Lefrancois (2,794,005 to The M. W. Kellogg Co.) prepares a molybdena alumina catalyst by-passing an oxygen containing gas through a mass of an oxide of molybdena of lower form than MoO_3 and an alumina containing material at a velocity sufficient to form a dense fluidized mass and at 1000-1700° F.

A platinum-refractory inorganic oxide supported catalyst is prepared according to V. Haensel and M. J. Murray (2,818,394 to Universal Oil Products Co.) by impregnating the support with a platinum containing solution in a series of stages and after each of a plurality of such stages heating the impregnated support first in an oxidizing, then in a reducing atmosphere at 500-1100° F. A platinum-alumina catalyst is prepared by E. J. Bicek (2,798,-051 to Universal Oil Products Co.) by successively treating alumina with vaporous platinum carbonyl chloride and water vapor. A catalyst comprising 0.01-5% platinum, 0.3-5% gallium oxide and the remainder alumina is disclosed in The M. W. Kellogg Co.'s 2,814,599 (P. A. Lefrancois, E. W. Riblett and W. P. Burton). The same inventors in The M. W. Kellogg Co.'s 2,818,393 propose a reforming catalyst, prepared by combining platinous tetrammino chloride mercuric acetate and alumina and heating the resulting mixture to decompose the ammine to a metallic residue on the alumina.

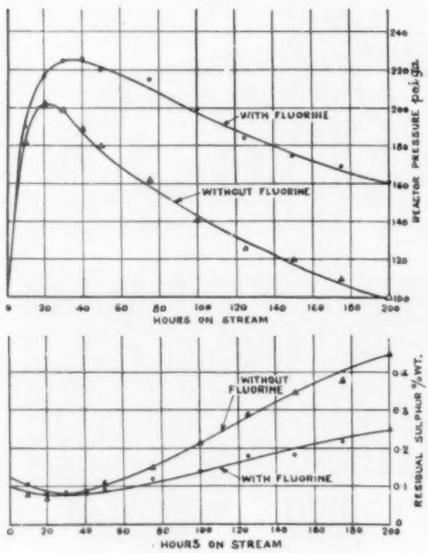
Methods for the recovery of platinum from spent catalysts are contained in three typical patents. According to T. H. Milliken, Jr. (2,806,004 to Houdry Process Corp.) carbon is added to a platinum-alumina catalyst and the alumina is then dissolved in strong caustic. The residue is treated at oxidizing conditions to remove carbon and the platinum is finally dissolved in aqua regia. In one of two Universal Oil Products Co.'s patents, H. R. Appell dissolves platinum in aqua regia and then precipitates it from solution in the presence of a compound such as hydrazine, which prevents the redissolving of the platinum. J. G. Leopard in 2,710,799 dissolves the y-alumina of a spent platinum-alumina catalyst in sulfuric acid, removes the solution, dissolves α-alumina in caustic and removes the solution, which leaves platinum in solid form.

A hydrogenation catalyst comprising reduced cobalt on preformed activated carbon pellets is prepared according to J. K. Mertzweiller (2,808,443 to Esso Res. & Eng. Co.) by impregnating the pellets with the cobalt salt of a cobalt corbonyl. P. N. Rylander and W. J. Zimmerschied (2,805,187 to Standard Oil Co. of Indiana) disclose a hydrodesulfurization catalyst consisting of cobaltous ferrite or nickelous ferrite. The ferrite is prepared by calcining an intimate mixture of a compound affording an oxide of iron and an oxide of nickel or cobalt at 1800-2000° F., the molar ratios of Co:Fe or Ni:Fe being 0.5:1. (See accompanying graph).

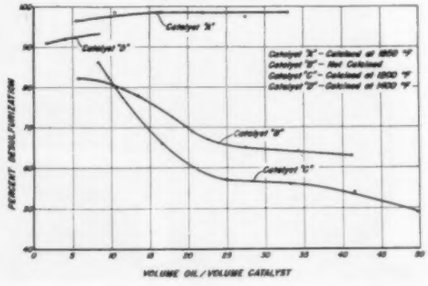
A steam reforming catalyst is the subject of American Cyanamid Co.'s 2,825,700 (K. D. Ashley and W. B. Innes). The catalyst, possessing increased crushing strength comprises a hydrated mixture of basic nickel carbonate filter cake and a hydraulic cement, containing at least 10% of an alkaline earth metal oxide.

END

USA Patent 2,800,429, dated July 23, 1957, to F. W. Porter, D. A. Howes, and J. E. Morris: "Effect of fluorine in cobalt-molybdena catalyst on sulfur removal and catalyst life."



USA Patent 2,805,187, dated September 3, 1957, to P. N. Rylander and W. J. Zimmerschied: "Effect of catalyst calcination temperature on desulfurization and catalyst life."



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OIL COMPANY STAFF CHANGES

A. E. C. Drake

W. H. Hesketh

ARTHUR ERIC C. DRAKE has been elected a director of The British Petroleum Co. Ltd. to succeed Robert Gillespie, who retired on June 30. Mr. Drake is a director of BP Trading Ltd., the company's principal trading subsidiary. He has served the company in the Middle East, in London, and in the United States.

During 1948 and 1949, Mr. Drake successfully conducted important negotiations with the Syrian government on behalf of Middle East Pipelines Ltd. In 1951, he was appointed general manager in Iran and Iraq. Upon his return to London from Iran, he went to Australia, and there carried out negotiations with both the federal and western Australian governments which resulted in the signing of the Kwinana Oil Refinery Agreement in March 1952. He was U.S.A. representative from December 1952 to March 1954. He was appointed a director of BP Trading Ltd. in February 1957. In the 1952 New Year's Honors, Mr. Drake was awarded the CBE.

W. ALLEN TAFT, director of sales of DuPont's photo products department, has been named director of sales of the company's petroleum chemicals division. He succeeds W. Samuel Carpenter III, who was recently appointed assistant general manager of the electrochemicals department. Mr. Taft started with the company's explosives department in 1935 as a chemist.

Dr. BERNARD M. STURGIS, director of the DuPont's petroleum laboratory, has been named secretary of the division of petroleum chemistry of the American Chemical Socy. He succeeds W. G. Lovell of the Ethyl Corp., who had held the post for several years.

JOHN D. BAILIE has been appointed to the newly created position of manager of sales technical services for Ethyl Corp. He will be located in New York. In his new capacity, he will coordinate technical activities for Ethyl's sales department. Mr. Bailie, who has been associated with Ethyl for 19 years, was formerly chief refining technologist in Chicago, where he is succeeded by William W. Sabin.

ROSS E. WILLIAMS has been appointed assistant to the vice president and general manager of domestic and foreign crude-oil production for The Atlantic Refining Co., Philadelphia, Pa.—succeeding A. B. Macaulay, who has been named the new manager for the company's Oklahoma-Kansas producing region. A graduate of Drexel Inst. of Technology, Mr. Williams joined Atlantic in 1935. After serving in the producing accounting section in the firm's Philadelphia headquarters, he was transferred to Dallas in 1942 as assistant chief accountant in the southwest accounting section, and in 1952 was named chief accountant.

GEORGE H. UNZELMAN has been promoted to technical assistant—advertising and sales promotion, for Ethyl Corp., New York. He will coordinate technical advertising and also provide technical assistance to the advertising and sales-promotion staff. Mr. Unzelman joined Ethyl in 1955, and served as a member of the refinery technology division in the company's Detroit research laboratories. Since 1956 he has been a sales refinery technologist in the southern region of the sales department.

EDWARD R. KINSLEY, manager of European operations for Geophysical Service Inc., subsidiary of Texas Instruments Inc., has been awarded a Sloan fellowship for one year of advanced study at the School of Industrial Management of the Massachusetts Institute of Technology.

WILLIAM H. HESKETH, a New Jersey-born refinery engineer with extensive international experience, has been elected the first president of Standard-Vacuum Refining Corp. (Philippines)—with headquarters in Manila. Mr. Hesketh, who recently completed an assignment as acting manager of the Stanvac refinery in Bombay, is chief executive officer for a refinery costing about $33.5 million to be built on the Bataan peninsula. The new refinery will represent the largest single private investment project in the Philippines.

RICHARD I. GALLAND has been named president of American Petrofina Co. of Texas, operating division of American Petrofina Inc. He will have offices in Dallas, and will also serve as vice president and general counsel of American Petrofina Inc. J. M. Shea, Jr., and Frank Durham have been named vice presidents of the company. Other officers of the operating division are D. R. Zachry, Sr., executive vice president, and Verne H. Maxwell, vice president and general counsel.

PERRY C. ARNOLD, Chicago Bridge & Iron Co. field welding engineer, has been awarded the American Welding Society's James F. Lincoln Gold Medal for "the greatest original contribution to the advancement and use of welding equipment to be published in the *Welding Journal* during 1957." He received the medal and a certificate during the opening session of the society's recent annual meeting in St. Louis.

E. F. LIEBRECHT has been named president of Kellogg International Corp., subsidiary of M. W. Kellogg Co. of New York. He will establish his offices in London to direct operations in the United Kingdom, Europe, Australia, and the Middle East.

J. FLETCHER NELSON has been elected treasurer for Cities Service Co., New York—succeeding H. J. McCusker, retired after 39 years' service. Mr. Nelson joined the company in 1929, and has held numerous financial and other executive positions.

ALAN BEERBOWER, chemical engineer with the Baltimore refinery of Esso Standard Oil Co. for the past 12 years, has rejoined staff of Esso Research and Engineering Co., at Linden, N. J. Prior to his association with the Baltimore refinery, Mr. Beerbower spent nine years with Esso Research.

DR. LOUIS E. KIDWELL—formerly research chemist for Monsanto Chemical and Shell Oil Co., and a chemist with Phillips Petroleum Co.—has been named manager of the organic chemistry section of the Dept. of Chemistry and Chemical Engineering, Southwest Research Inst., San Antonio, Texas.

MONROE E. SPAGHT, executive vice president of Shell Oil Co., has been awarded an honorary doctor of science degree by Rensselaer Polytechnic Institute. Dr. Richard G. Folsom, president of Rensselaer, presented the degree in recognition of Mr. Spaght's "achievements as a scientist and industrial executive."

LEONARD ACQUAVIVA and **E. HAROLD PAULU** have been appointed engineering associates of Esso Research & Engineering Co., Linden, N. J. A company veteran of 29 years, Mr. Acquaviva spent three years in the 1930's on the island of Aruba, Netherlands Antilles, with Lago Oil and Transport Co. Mr. Paulu, with the company for 22 years, has concentrated mainly on mechanical equipment for refineries. Included in his many overseas assignments are trips to affiliate refineries in Holland, England, France, Germany, and Venezeula. His most recent out-of-the-states assignment was in Sumatra a year ago.

R. E. LUTON, vice president for refining, has been elected a director of The Ohio Oil Co., Findlay, Ohio, succeeding H. C. King, retired.

WILLIAM T. CONNER has been appointed manager of the newly created Market Research Department of the American Oil Co., with headquarters at New York. Formerly senior marketing analyst in the distribution economics department of Standard Oil Co. (Indiana), American parent, he will report to G. M. Glazier, assistant general manager of sales.

H. A. LORD has been appointed general manager of the engineering department of The Texas Co., New York. Formerly he was superintendent of Texaco's Lockport, Ill., works. **R. E. NAGLE** has been appointed chief engineer of the company at New York—succeeding H. B. Peters, retired.

R. C. BEAL has been appointed chief engineer of the manufacturing department of the British American Oil Co. Ltd.

WILLIAM V. RATHBONE and **MARTIN F. DRYDEN, Jr.**, have been elected to the board of General Gas Corp., Baton Rouge, La. Mr. Dryden has been a vice president in charge of sales of Delta Tank Manufacturing Co. Inc., wholly owned General Gas subsidiary. Earlier he had been executive vice president of Parkersburg Rig & Reel Co., and formerly was associated with Standard Oil Co. (N. J.).

HAROLD D. OSBORN has been elected a director and treasurer of General Petroleum Corp., Los Angeles, Calif.—succeeding the late James T. Durkee. Mr. Osborn also becomes comptroller of the company. Mr. Osborn joined General Petroleum in 1923, and since has held various positions in the comptroller's department.

W. F. BROWN, Denver, Colo., has been promoted to manager of manufacturing for Continental Oil Co.'s Rocky Mountain region.

JOHN B. DUCKWORTH has been appointed research coordinator in the Standard Oil Co. (Indiana) research department, at Chicago, Ill.—responsible for liaison between the company's research department and major automotive manufacturers and government agencies concerned with trends in petroleum-product quality. Previously he had been division director of automotive research at the company's Whiting, Ind., research laboratories.

A. E. C. DRAKE, CBE, joined the board of British Petroleum Co., July 1. He fills a vacancy caused by retirement of Robert Gillespie, CBE, who remains on the boards of BP Tanker Co. Ltd. and BP Clyde Tanker Co. Ltd. **J. HOUSTON JACKSON** becomes managing director BP Tanker Co. He had been a director and general manager. Succeeding Mr. Jackson as general manager is **D. G. L. BEAN**, formerly deputy general manager. **W. D. BROWN** becomes a director of BP Trading Ltd., BP's principal trading subsidiary, to fill vacancy caused by retirement of Mr. Gillespie. Mr. Brown had been general manager, trade division.

Dr. DANIEL P. BARNARD, who began tinkering with gasoline engines before he was 10 years of age, retired as research coordinator for Standard Oil Co. (Indiana), Chicago—a post he had held for 10 years. Widely known for his 33 years of research devoted to tailoring fuels and lubricants to fit engines for improved service, Dr. Barnard also served as president of Coordinating Research Council Inc.; chairman of the API Automotive Research Committee; and president of Socy. of Automotive Engineers—from which he received the 1949 Horning award for "distinguished active service in the field of mutual adaptation of fuels and engines."

Kerr-McGee Foreign Exploration

A foreign exploration division has been established by Kerr-McGee Oil Industries Inc., under the direction of J. C. Finley, vice president. In addition, Mr. Finley is responsible for matters pertaining to acquisition of domestic properties.

Exploration activities in USA and Canada are now handled by Harold J. Kleen, formerly chief geologist; now exploration manager. Geological, geophysical, land and lease records departments report to Mr. Kleen. Ralph McVay continues as superintendent of the land department—with Walter Marlin becoming his special assistant.

John Masters has been promoted to chief geologist—with all geological districts and divisions under his supervision. L. W. Curtis becomes assistant chief geologist. Jere McKinney has been promoted to district geologist—with headquarters at Oklahoma City.

F. G. Straka

Frank G. Straka, 53, chief coordinating engineer of Universal Oil Products Co., died unexpectedly May 17, at his summer cottage near Fox Lake, Ill. As chief coordinating engineer, it was Mr. Straka's responsibility to oversee the design of all processes and plants engineered by Universal.

BP MAPS THE FUTURE

Minutes saved in fuelling an aircraft mean a quicker journey for its passengers. Here, at Lisbon Airport, a BP man connects a mobile dispenser to the hydrant pit of the underground pipeline. The huge plane will be completely fuelled in about 15 minutes.

1200 Gallons a Minute

ASTONISHING FUELLING SYSTEM SPEEDS THE WORLD'S AIRLINES

AIRLINERS HAVE A MAMMOTH THIRST. Today's biggest planes need as much as 18,000 gallons when they are fuelled. Tomorrow's planes will need 'fill-ups' of 24,000 gallons.

How to deliver such enormous quantities of fuel safely and at high speed sets a new problem. But that problem is being solved. Solved by the Hydrant System which, with the advice of BP, is being installed at an ever increasing number of the world's major airports.

How It Operates

Previously, fuel was always brought to an aircraft by a mobile tank fueller. Now, with the Hydrant System, it may be piped from the airfield depot direct to a hydrant on the concrete apron. From the hydrant the fuel passes to a mobile fuel dispenser which filters and controls its flow, and from this to the aircraft.

Torrential Speed

The great advantage of the Hydrant System is that virtually unlimited quantities of fuel can be delivered at *torrential speed – with complete safety*. In principle the system is simple but (particularly because of the pressures set up) to make it practicable has involved an immense amount of research and experiment by BP technicians.

This new development in aircraft refuelling is just one more way in which The British Petroleum Company plans for the future – today.

THE BRITISH PETROLEUM COMPANY LIMITED

OIL REFINERIES OF THE WORLD

The tabulation below has been prepared to show the present capacities and status of oil refineries outside the United States where such information is available. Estimated data is given on USSR plants and refineries in nations dominated by the Russians. Capacities are in barrels per calendar day. Key to type of plant: S—Skimming; L—Lubricating; A—Asphalt; H—Hydrogenation; C—Cracking; Comp.—Complete. Under cracking capacity to indicate type: T—Thermal; C—Catalytic.

SUMMARY OF REFINERY CAPACITIES

Operating or Operable Capacities July 1, 1958

Country	No. of Plants	Crude Capacity Barrels per Calendar Day	Cracking Capacity Barrels per Calendar Day
Aden	1	120,000	—
Albania	2	6,000	—
Angola	1	2,000	—
Argentina	17	243,670	118,000TC
Australia	7	205,500	56,500C
Austria	8	39,660	11,000T
Bahrain Island	1	186,500	43,320TC
Belgium	8	175,100	25,500TC
Bolivia	4	11,900	—
Brazil	8	111,800	16,400T
British Borneo	1	50,000	—
Bulgaria	1	5,000	—
Burma	2	6,500	—
Canada	43	792,120	352,825TC
Chile	2	26,740	4,500T
China	6	47,000	—
Colombia	5	69,500	39,000C
Cuba	6	84,700	22,900TC
Czechoslovakia	4	26,000	—
Denmark	3	980	—
East Germany	2	4,800	—
Ecuador	2	5,650	—
Egypt	3	76,200	9,000T
Finland	1	20,000	11,000C
Formosa	1	28,000	10,000TC
France	15	674,870	135,400TC
Germany	27	348,910	80,300TC
Greece	1	27,000	—
Hawaiian Islands	1	3,000	—
Hungary	5	34,000	—
India	4	104,500	29,600TC
Indonesia	5	242,800	74,000TC
Iran	3	415,000	27,000C
Iraq	4	45,630	18,000T
Israel	1	87,000	23,500T
Italy	35	684,865	60,665TC
Japan	23	503,560	42,850TC
Kuwait	1	190,000	—
Lebanon	2	20,500	—
Mexico	8	319,000	46,500TC
Morocco	1	2,400	1,400C
Netherlands	2	346,000	95,000TC
Netherlands West Indies	2	650,000	213,000TC
Neutral Zone	1	50,000	—
Norway	1	2,100	—
Pakistan	1	7,500	—
Peru	3	46,000	14,500T
Philippine Islands	1	13,000	5,400C
Poland	5	15,000	—
Portugal	1	27,000	10,000C
Puerto Rico	2	65,500	32,000C
Qatar	1	600	—
Romania	15	230,000	—
Saudi Arabia	1	189,000	—
South Africa	2	23,000	12,000TC
Spain	3	150,700	3,500T
Sweden	5	50,800	1,000T
Switzerland	2	1,850	—
Trinidad	3	142,000	54,500TC
Turkey	1	6,250	3,580C
United Kingdom	16	778,400	127,300TC
USSR	70	1,950,000	600,000TC
United States	298	9,186,000	6,400,000TC
Uruguay	1	28,000	7,000TC
Venezuela	15	791,370	118,460TC
Yugoslavia	3	22,700	6,400TC
Totals	**730**	**20,821,125**	**8,929,847**
Western Hemisphere		12,573,950	7,406,432
Eastern Hemisphere		8,247,175	1,523,415

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Aden:				
BP Refinery (Aden) Ltd.	Little Aden [1]	120,000	S	—
Albania:				
Government	Cerrik	3,000	SA	—
	Stalin	3,000	SA	—
Angola:				
Lobito Purifina	Luanda	2,000	S	—
Australia:				
Australian Oil Ref. Ltd.	Kurnell, NSW [1]	31,000	SC	14,000C
Bitumen & Oil Refineries Ltd.	Sydney [2]	13,500	SA	—
	Hamilton	2,000	SA	—
BP Refining (Kwinana) Ltd.	Kwinana [3]	70,000	SC	12,500C
Shell Ref. Pty Ltd. (Aus.)	Clyde [4]	10,000	SLA	—
Shell Ref. Pty (Aus.)	Geelong [5]	46,000	SC	15,000C
Standard Vacuum Refining Co. (Australia) Pty. Ltd.	Altona [6]	33,000	SLA	15,000C
Austria:				
A.G. der Shell	Florisdorf	4,500	SLA	—
Mobil Oil (Austria) A.G.	Kagran	3,400	SLA	—
Argentina:				
Cia. General Asfaltos	Wilde (B.A.)	370	L	—
Esso Refinadora de Petroleo	Campana (B.A.) [1]	37,000	Comp.	17,500T
	Bahia Blanca (B.A.) [1]	10,000	CS	5,000T
	Manuel Elordi (Salta)	1,500	S	—
	Dadin (P. Huincol)	500	S	—

[1] 12,000 b/d catalytic reformer, 12,000 b/d thermal reformer.

[1] 5,500 b/d propane decarbonization and 1,500 b/d polymerization, crude capacity being increased to 42,000 b/d.

[2] 2,300 b/d Platforming and 2,300 b/d Unifining, 5,000 naptha Unifiner.

[3] 6,000 b/d Platformer; 5,600 b/d desulfurization.

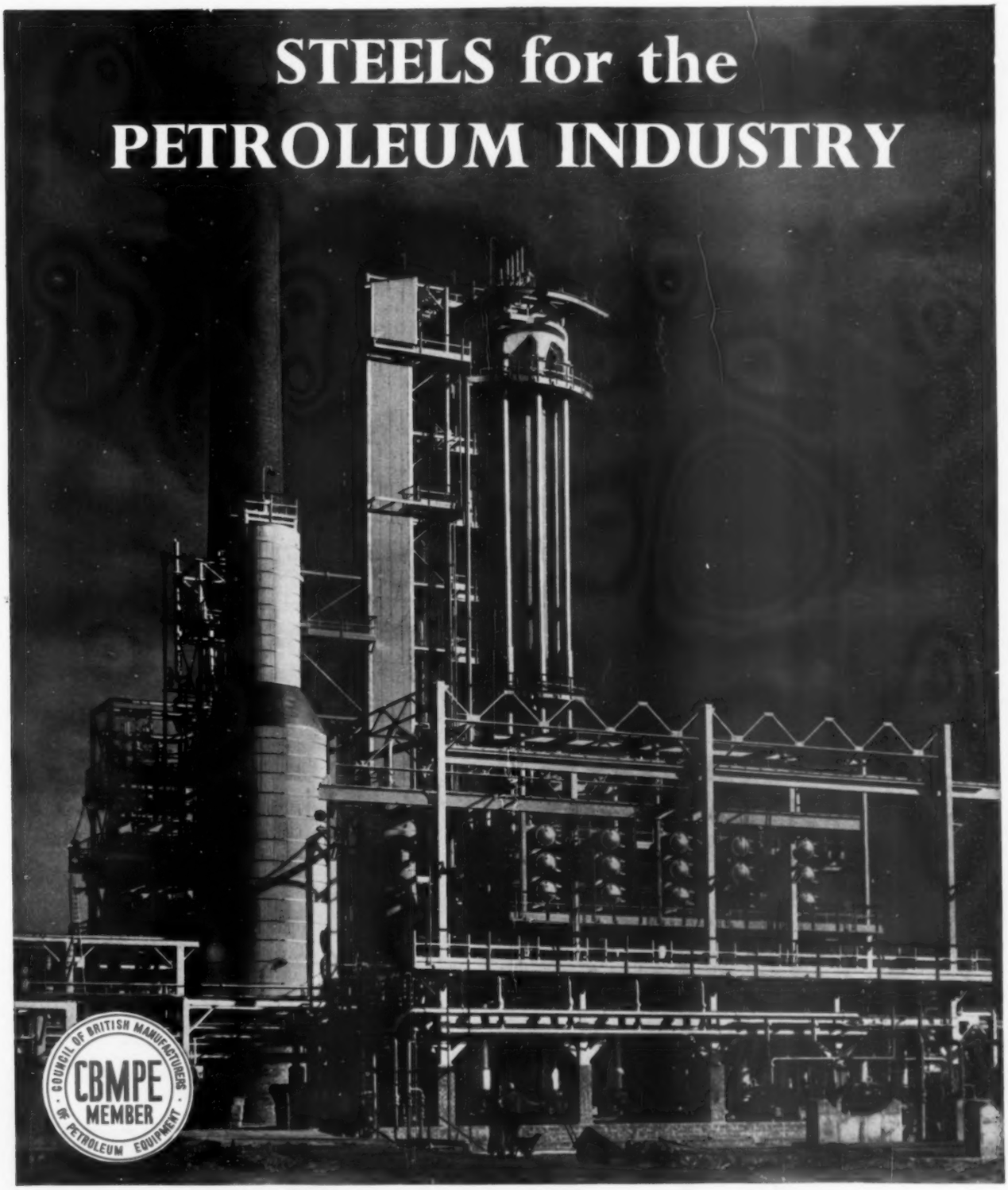
[4] 6,700 catalytic reformer building, late 1958 completion.

[5] 6,700 b/d catalytic reformer; 2,800 b/d cat poly; 11,000 b/d hydrodesulfurizer projected for late 1959 completion.

[6] 5,400 b/d Sovaformer; 1,700 b/d alkylation unit; to expand crude capacity to 41,000 b/d and add cat. desulfurization and sulfur recovery by mid 1959.

[7] 24,000 b/d refinery near Adelaide, South Australia, planned by Standard Vacuum Refining Co.

THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND



"A Symphony In Steel" —A British Petroleum Company photograph

THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND

APPLEBY-FRODINGHAM STEEL COMPANY · SAMUEL FOX & COMPANY LIMITED · UNITED COKE & CHEMICALS COMPANY LIMITED
STEEL PEECH & TOZER · UNITED STEEL STRUCTURAL COMPANY LIMITED · WORKINGTON IRON & STEEL COMPANY
DISTINGTON ENGINEERING COMPANY LIMITED · OWEN & DYSON LIMITED YORKSHIRE ENGINE COMPANY LIMITED

THE UNITED STEEL COMPANIES LTD

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Condor	Lomas de Zamora (B.A.)	800	SL	—
Diadema Argentina SA de Petroleo	Buenos Aires [2]	38,000	Comp.	9,000T
La Isaura	Bahia Blanca	1,800	SC	1,000T
Loterro y Papini	Avellaneda (B.A.)	800	SL	—
Ragor SA	Quilmes (B.A.)	300	SL	—
YPF (Ende)	Dock-Sud Avellaneda (B.A.)	5,500	Comp.	3,000T
	La Plata [3]	100,000	Comp.	56,000TC
	San Lorenzo (Santa Fe)	22,000	SC	13,000T
	Lujan de Cuyo [4] (Mendoza)	14,000	SC	9,000T
	Chachapoyas (Salta)	3,500	SC	1,300T
	Plaza Huincul (Nequen)	2,800	SC	1,100T
Petroquimica (E.N.)	Comodoro Rivadavia	4,800	SC	1,500T

[1] 47,000-bbl pipe still, on project for completion 1960.
[2] 3,000 b/d cat reforming methylethylketone dewaxing plant under construction; complete 1959.
[3] 18,400 b/d fluid catalytic cracking capacity and 7,000 b/d thermal cracking capacity.
[4] Expansion to 26,000 b/d underway, including delayed cooking and catalytic cracking facilities. M. W. Kellogg Co. to install these new facilities which will be complete about 2½ years from signature of contracts not yet signed.
[5] Bids currently under consideration for 18,900 b/d expansion to include lube plant, and naptha reforming.

Note: New 38,000 b/d refinery planned by YPF at Bahia Blanca. Bids currently being received.

Richard K. van Sickle	Neuseidl/Zaya	360	S	—
Oesterreichische Mineraloelwerke	Voesendorf	2,300	SLA	—
	Korneuburg	7,000	SLA	—
	Schwechat	13,300	Comp.	5,000T
	Lobau	8,800	S	—
	Moosbierbaum	10,000	SC	6,000T

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Bahrain Island:				
Bahrain Petroleum Co.	Behrain, Persian Gulf [1]	186,500	SCA	43,320TC

[1] 19,950 b/d thermal reforming, 16,020 b/d thermal cracking and 27,300 b/d catalytic cracking; 10,450 b/d Platformer; 2,050 b/d cat. polymerization; 116,600 t/y asphalt.

Belgium:

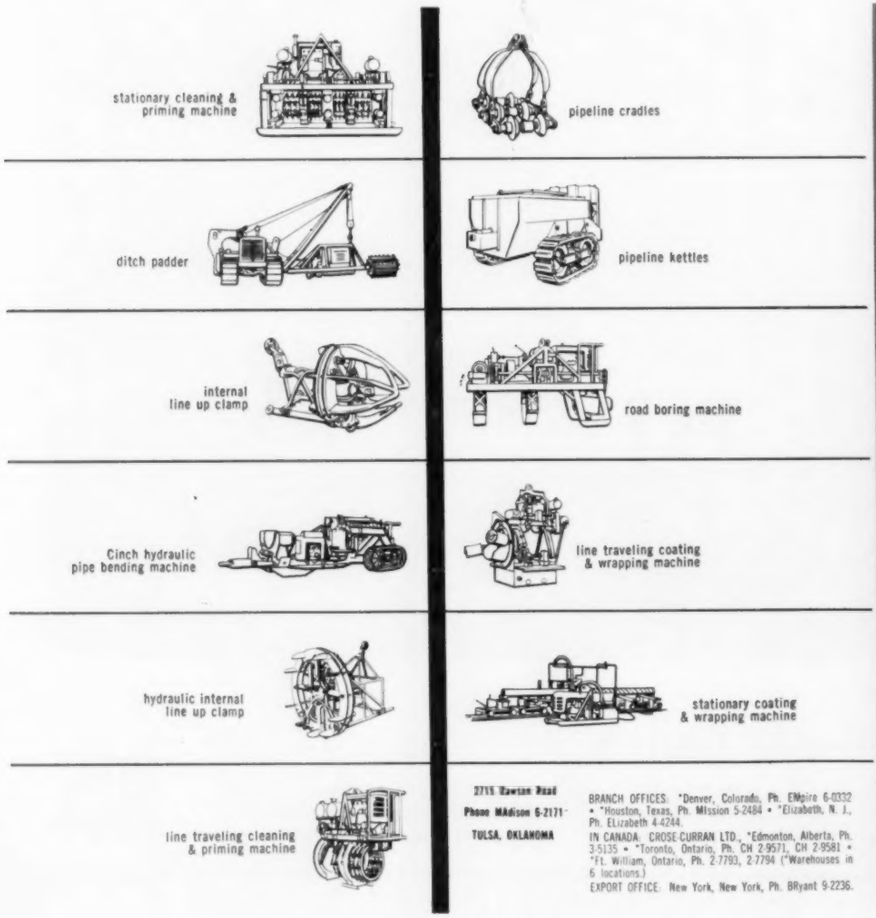
"Albatros" S.A. Belge pour le Raffinage de Petrole	Antwerp, Kiel [1]	14,000	SC	4,500C
Belgian Shell Co. S.A.	Ghent	3,000	SLA	—
Compagnie Industrielle "Atlas" S.A.	Hoboken-Antwerp	2,500	S	—
Esso Belgium, S.A.	Antwerp [2]	35,000	SC	11,000C
Raffineries Belge des Petroles	Antwerp [3]	18,600	SC	—
Raffineries et Distilleries Anversoise S.A. "Radan"	Antwerp [6]	8,500	S	—
Soc. Industrielle Belge des Pet.	Antwerp [4]	90,000	SCA	10,000C
Tankage et Transport S.A.	Antwerp [5]	5,500	S	—

[1] 700 b/d Cat. poly.
[2] 4,000 b/d thermal reforming, 5,000 b/d cat reformer; asphalt plant and 6,000 b/d Hydrofiner.
[3] 2,600 b/d thermal reforming; 2,500 b/d cat reforming; 5,000 b/d asphalt topping and 5,000 b/d cat desulfurizer building, 1959 completion.
[4] A 10,000 b/d Hydrofiner; 10,000 b/d cat reformer; 3,000 b/d cat poly; 6,000 b/d thermal reformer.
[5] 750 b/d Platforming capacity.
[6] 750 b/d cat. reformer.

Bolivia:

Yacimientos Petroliferos Fiscales Bolivianos	Cochabamba [1]	6,000	SL	—
	Sucre	4,000	S	—
	Camiri	1,500	S	—
	Sanandita	400	S	—

[1] 1,500 b/d Platformer under construction.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ditch padder
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FOUR 99

1·6 litre diesel engine

FOR GOODS AND PASSENGER VEHICLES, MOTOR CARS, TAXICABS, AGRICULTURAL APPLICATIONS AND INDUSTRIAL PLANT AND EQUIPMENT OF ALL KINDS

Commercial and passenger vehicle ratings: 42.3 b.h.p. at 3,600 r p.m.
Motor car ratings: 43 b.h.p. at 4,000 r.p.m.
Agricultural ratings: 35 b.h.p. at 3,000 r.p.m.
Industrial ratings: 32 b.h.p. at 3,000 r.p.m. for continuous operation in approved applications under conditions of B.S.S. 649/1949. 35 b.h.p. at 3,000 r.p.m. to suit intermittent loading.

R.A.C. certified fuel consumption in Vauxhall Velox car 56.6 m.p.g. at average speed of 34.8 m.p.h. over test route of 218 miles. Similarly R.A.C. certified fuel consumption for a Ford Consul was 50.8 m.p.g. at average speed of 34.7 m.p.h.

This engine is no ordinary diesel—it is a tremendous step forward; we are in a new era here of flexible power with economy in fuel consumption which we have not hitherto found possible.

The four 99 engine will cater for the greatest multiple size of vehicle in operation today with greater power and economy than any other power unit available.

for ST. CUTHBERTS CO-OPERATIVE ASSOC LTD.
TRANSPORT DEPT., GARDNERS CRESCENT,
EDINBURGH.

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Transport Manager.

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Please let me have details of the new Four 99 Diesel engine.

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1511CV

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Brazil:				
Companhio de Petroleo da Amazonia	Manaus	5,000	SC	2,000C
Distillaira Riograndense de Uruguania Petroleo S.A.	Rio Grande do Sul	300	S	—
Industrias Matarazzo de Energia S.A.	Sao Paulo	500	S	—
Petroleo Brasileiro S.A. (Petrobras)	Mataripe [1]	5,000	SC	3,000T
	Cubatao [2]	65,000	SC	8,000T
Piranga S.A. Cia Brasileira de Petroleo	Rio Grande do Sul	6,000	SCA	2,000T
Refinaria e Exploracao de Petroleo Uniao	Sao Paulo [3]	20,000	S	—
Refinaria de Petroleo de Manguinhos	Rio de Janeiro	10,000	S	3,400T

[1] Crude capacity to be increased to 37,000 b/d, 2,800 b/d lube plant; complete late 1958.
[2] 116,000 tons/year asphalt capacity. Under construction: Crude capacity to be increased to 100,000 b/d in 1958. Current crude runs 73,000 b/d. Ethylene recovery. Fertilizer plant 110 t/y.
[3] Actually processing 31,000 b/d.
Note: Petrobras building 90,000 b/d refinery at Caxias and is planning two others at undisclosed locations.

British Borneo:				
Sarawak Oilfields Ltd.	Lutong, Sarawak	50,000	S	—
Bulgaria:				
Government	Russe [1]	5,000	SA	—

[1] Asphalt plant to be doubled in 1959 to 40,000 t/y.

Burma:				
Burmah Oil Co. (1954) Ltd.	Chauk	3,000	S	—
	Syriam	3,500	S	—
Nathsingh Oil Co. Ltd.	Yenangyaung [1]	480	L	—

[1] Wax plant under construction.

Canada:				
Anglo-Canadian Oil Ltd.	Brandon, Man. [1]	2,670	SC	1,375T
Anglo-American Exp. Ltd.	Hartell, Alta. [2]	4,000	SC	1,500T
Bonnyville Oil Refineries	Bonnyville, Alta.	1,000	S	—
British American Oil Co. Ltd. [4]	Calgary, Alta. [3]	6,750	SC	2,250T
	Edmonton, Alta. [4]	7,650	SC	2,060TC
	Moose Jaw, Sask. [5]	13,500	SCA	5,400TC
	Clarkson, Ont. [7]	55,350	Comp.	14,490TC
	Montreal, Que. [8]	45,000	SCA	19,800C
	Port Moody, B.C.	18,000	SC	3,600C
Canadian Oil Refineries Ltd.	Sarnia, Ont. [9]	27,500	SC	16,000TC
Canadian Petrofina	Montreal, Que. [10]	30,000	Comp.	16,000C
Consumer's Co-operative Ref.	Regina, Sask. [11]	16,000	SCA	8,000TC
Excelsior Refineries Ltd.	Lloydminster, Alta.	3,500	SA	—
Canadian Husky Oil Ltd.	Lloydminster, Alta.	7,990	SA	—
	Ft. Williams, Ont. [12]	3,760	SA	—
	Moose Jaw, Sask. [13]	3,000	SA	—
Imperial Oil Limited	Montreal, Que. [14]	71,800	SCA	19,500TC
	Halifax, N.S. [15]	44,500	Comp.	17,000C
	Sarnia, Ont. [16]	77,000	Comp.	20,000TC
	Winnipeg, Man. [17]	18,000	SCA	6,000C
	Regina, Sask. [18]	22,500	SCA	12,550TC
	Edmonton, Alta. [19]	28,500	Comp.	14,500TC
	Calgary, Alta.	6,750	SCA	4,600T
	Vancouver, B.C. [20]	30,000	SCA	7,650C
	Norman Wells, NWT	1,300	S	—
McColl-Frontenac Oil Co. Ltd.	Montreal E. Que. [21]	59,000	SC	32,000TC
	Edmonton, Alta. [22]	12,000	SC	8,700TC
	Port Credit, Ont. [23]	20,000	SC	10,600TC
New Brunswick Oilfields Ltd.	Weldon, N.B.	300	S	—
Northern Petroleum Corp. Ltd.	Kamsack, Sask.	1,000	S	—
North Star Oil Ltd.	St. Boniface, Man.	12,000	SC	5,177C
	Grand Prairie, Alta.	2,500	SC	1,100T
Prince Albert Refineries Ltd.	Prince Albert, Sask.	1,000	S	—
Petroleum Fuels Ltd.	Moose Jaw, Sask.	1,000	S	—
Royalite Products Ltd.	Kamloops, B.C. [24]	5,000	SA	1,350C
	Coleville, Sask.	5,000	SA	—
Radio Oil Refineries Ltd.	East Kildonan, Man.	2,000	S	—
Royalite-Hiway Ltd. (Royalite Oil Co.)	Saskatoon, Sask.	6,500	SCA	2,470TC
Shell Oil Co. of Canada Ltd.	Shellburn, B.C. [25]	20,000	Comp.	10,100TC
	Montreal East [26]	60,000	Comp.	28,500TC
Standard Oil Co. of B.C. Ltd.	N. Burnaby, B.C. [27]	18,000	SC	9,000C
Sun Oil Co.	Sarnia, Ont. [28]	15,000	SC	11,000C
Wainwright Refineries Ltd.	Wainwright, Alta.	3,000	S	—
XL Refineries	Dawson Creek, B.C. [29]	2,800	SC	1,000T

[1] 1,200 b/d Platforming, 50 b/d cat. poly.
[2] 1,000 b/d catalytic reforming, 70 b/d cat. poly.
[3] 1,800 b/d catalytic reforming.
[4] 1,260 b/d thermal cracking, 1,800 b/d catalytic cracking, 4,860 b/d Catformer.
[5] thermal cracking 1,350 b/d, cat cracking 4,050 b/d, cat poly. 350 b/d, cat reforming 4,860 b/d to be completed third quarter 1958.
[6] Building 18,000 b/d refinery at Port Moody, B.C. for completion late 1958. Cat cracking 8,100 b/d and cat reforming 3,600 b/d to be included.
[7] 4,050 b/d thermal cracking, 10,440 b/d cat cracking, 9,000 b/d catalytic reforming, 1,134 b/d cat. poly., 12,000 b/d desulfurization unit planned for 1959.
[8] 19,800 b/d catalytic cracking, 11,700 b/d catalytic reforming, 15,500 b/d catalytic desulfurization, 567 b/d cat poly.
[9] 8,000 b/d Platforming, cat cracking 12,000 b/d, thermal cracking 4,000 b/d.
[10] 3,600 b/d cat reforming, 300 b/d cat poly, 1,400 b/d alklation, 3,000 b/d hydrodesulfurization.
[11] cat cracking 5,000 b/d, thermal cracking 3,000 b/d, cat poly. 1,200 b/d.
[12] 1,000 catalytic reforming.
[13] 650 b/d catalytic reforming, 100 b/d visbreaking.
[14] 19,500 b/d catalytic cracking and 9,450 b/d catalytic reforming, cat poly., 5,000 b/d.
[15] 17,000 b/d fluid catalytic cracking, 6,300 b/d catalytic reforming, 4,500 cat poly.
[16] 4,000 b/d thermal reforming, 19,300 b/d catalytic cracking capacity, 13,500 b/d Powerformer.
[17] 6,000 b/d catalytic cracking, 3,150 b/d Cat Powerformer.
[18] 4,500 b/d thermal cracking, 8,500 b/d catalytic cracking, 2,000 b/d cat poly.
[19] 6,000 b/d thermal cracking, 8,500 b/d catalytic cracking and 2,000 b/d Powerforming.
[20] 5,800 b/d Powerformer, 2,350 cat poly.
[21] 12,000 b/d thermal cracking, 20,000 b/d catalytic cracking, 11,000 b/d catalytic reforming, 10,000 b/d hydrotreating, 4,500 b/d cat poly.
[22] 4,700 b/d thermal cracking, 4,000 b/d catalytic cracking, 3,000 b/d Platformer, 750 b/d cat poly.
[23] 3,600 b/d thermal cracking, 7,000 b/d cat cracking, 2,100 b/d Platforming, 1,600 b/d cat poly.
[24] 1,000 b/d Platforming, 110 b/d cat poly.
[25] 4,500 b/d thermal cracking, 5,600 b/d catalytic cracking, 3,300 b/d Platformer, 600 T/D Asphalt, 3,300 b/d hydrotreater, 400 b/d cat poly.
[26] 8,000 b/d thermal cracking, 6,000 b/d Platforming, 20,500 b/d cat cracking, 9,000 b/d hydrotreating.
[27] 2,750 b/d Platforming.
[28] 3,000 b/d Houdriformer.
[29] 1,000 b/sd cat reforming.

China:

China is reported to have 6 plants with a combined capacity of about 47,000 b/d. Largest is Lanchow with capacity estimated at 14-20,000 b/d. Other major plants are at Tushantze and Yumen. Smaller (2,500-3,000 b/d) plants are at Darien, Chiahsien and Shanghai.

Chile:				
Empresa Nacional del Petroleo	Concon [1]	25,200	SC	4,500T
	Magallanes	1,540	S	—

[1] 4,600 b/d thermal reforming to be revamped as 8,000 b/d crude unit. For 1959 completion construction includes 30,000 b/d added topping, 12,000 b/d cat cracking and 6,000 b/d cat reforming.

Colombia:				
Colombian Petroleum Co.	Tibu	2,200	S	—
Empresa Colombiana de Petroleos	Barrancabermeja [1]	37,000	Comp.	14,000C
	La Dorada	4,200	S	—
International Petroleum (Colombia) Ltd.	Cartagena [2]	26,100	SC	25,000C
The Texas Petroleum Co.	Guamo	1,100	—	—

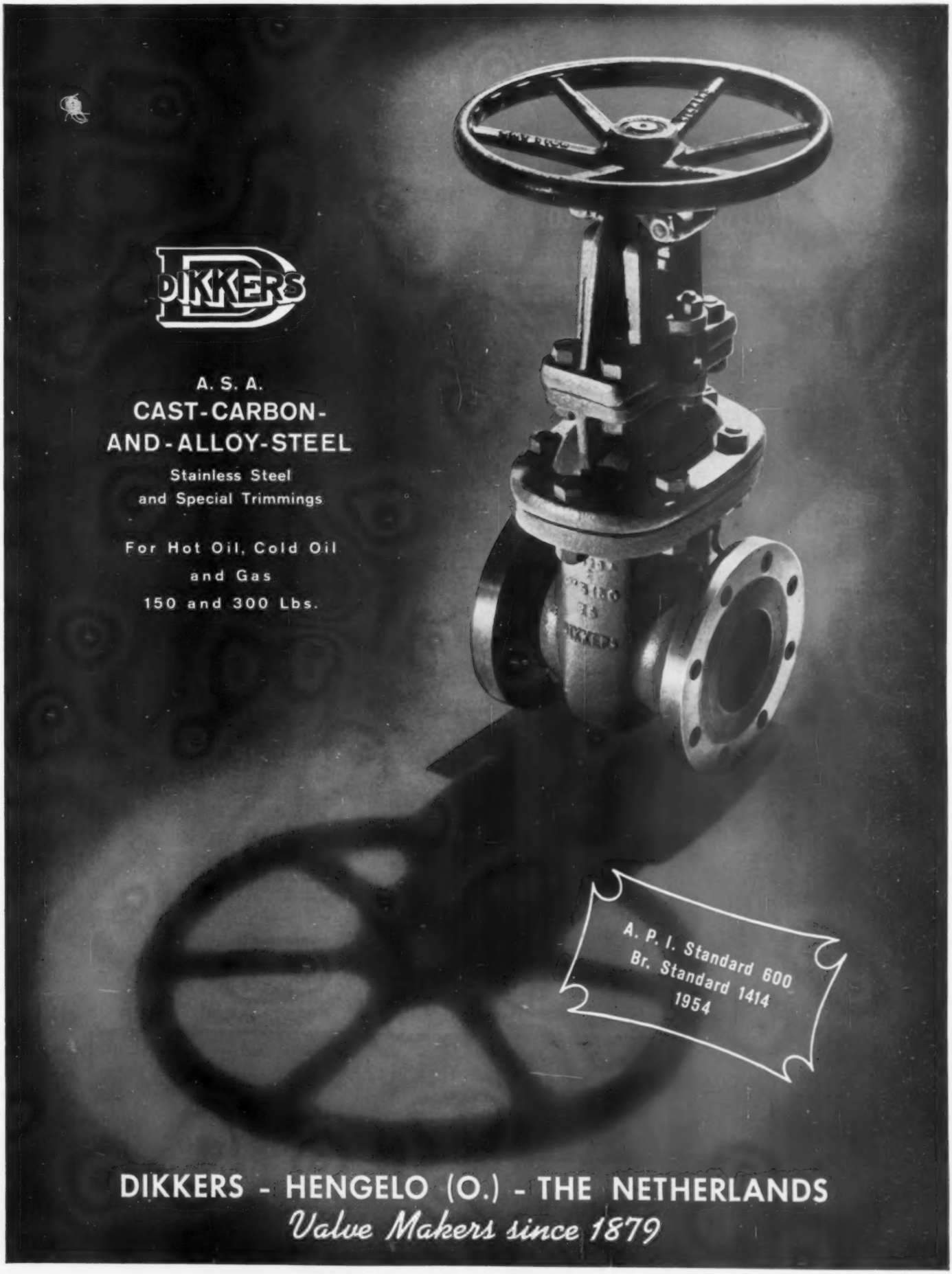
[2] 14,500 b/d visbreaking; 1,000 b/d H_2SO_4 alkylation.

Cuba:				
Compania Petrolera (Shell)	Havana [1]	27,000	S	—
Esso Standard Oil Co.	Belot [2]	35,000	SC	22,000C
Petrolera Jarahueca	Jarahueca	200	S	—
Refinadora Cabaiguan	Cabaiguan	2,000	S	900T
Refineria Bacuranao	Bacuranao	500	S	—
The Texas Co.	Santiago [3]	20,000	S	—

[1] 5,000 b/d cat. reformer.
[2] 2,400 b/d cat. reforming; 3,800 b/d cat. poly; 2,800 b/d hydrofiner.
[3] 3,300 b/d cat. reformer; 4,100 b/d Hydrotreating.

Czechoslovakia:

1957 crude runs estimated at 18,000 b/d; imports of crude totaled 792,000T and domestic production 105,000T.
New refinery near Bratislavia now partially in operation and will be expanded to 40,000 b/d by 1965.



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✱"Aquila", Societa Per Azioni Tecnico-Industriale
✱Arabian American Oil Co.
Arkansas Fuel Oil Corp.
✱Arkansas Louisiana Gas Co.
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Asia Oil Co.
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*Mitsubishi Oil Co., Ltd.
*Mitsui Petrochemical Industries
Mohawk Petroleum Corp.
*Monsanto Chemical Co.
*Montana Dakota Utilities Co.

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National Cooperative Ref. Ass'n.
*National Lead Co.
National Refining Co.
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Neville Chemical Co.
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Odessa Natural Gasoline Co.
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Old Dutch Refining Co.
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Onyx Refining Co.
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Pana Refining Co.
Panhandle Eastern Pipe Line Co.
The Parade Gasoline Co.
Paraffine Oil Co.
Pecos Petr. Co.
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Petrochemicals Ltd.
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*Petroleos Mexicanos (Pemex)
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*Phillips Petroleum Co.
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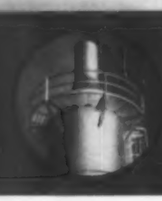
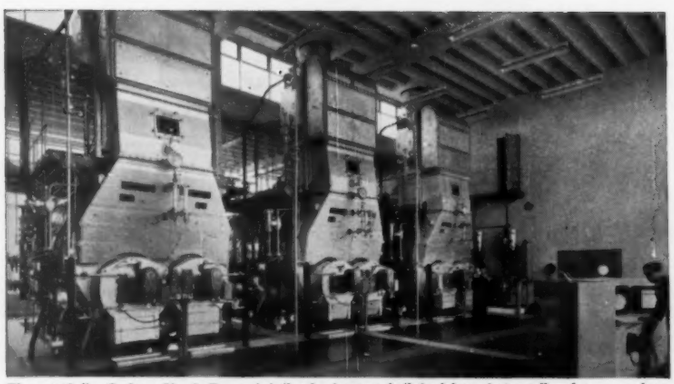


Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Denmark:				
A/S Kalundborg Oileraffinaderi	Kalundborg	850	S	—
Dansk Mineralolicfabrik	Copenhagen	60	SLA	—
L. C. Glad & Co.	Copenhagen	70	S	—
East Germany:				
It is estimated that two refineries in East Germany have a crude capacity of 4,800 b/d.				
Ecuador:				
Anglo-Ecuadorian Oilfields Ltd.	La Libertad [1]	5,200	S	—
Manabi Exploration Co.	Cautivo	450	S	—
[1] 7,700 b/d distillation unit and 6,000 b/d UOP thermal cracker under construction.				
Egypt:				
Anglo-Egyptian Oil Fields Ltd.	Suez [1]	44,000	SCA	6,500T
Raffinerie de Petrole du Government	Suez [2]	28,000	SA	2,500T
Societe Egypttienne pour la Raffinage	Alexandria [3]	4,200	S	—
[1] 4,000 b/d thermal reforming capacity. A 2,300 b/d Platformer is under construction; complete end of 1957.				
[2] 2,800 b/d thermal reforming; 800 b/d cat poly; proposed expansion to 30,000 b/d to include Platformer Hydrofiner and lube plant. Government operates a 1,200 b/d rerun plant at Cairo.				
[3] Cat. reforming 1,060 b/d.				
Finland:				
Neste Oy	Naantali	20,000	Comp.	11,000C
Note: 3,400 b/d cat reforming; 2,000 b/d cat poly.				
Formosa:				
Chinese Petroleum Corp.	Kaoshiung Taiwan [1]	28,000	SA	10,000C
[1] 4,000 b/d visbreaking; 3,000 b/d thermal reforming, 900 b/d alkylation unit and 10 t/d sulfur unit planned for completion end of 1958.				

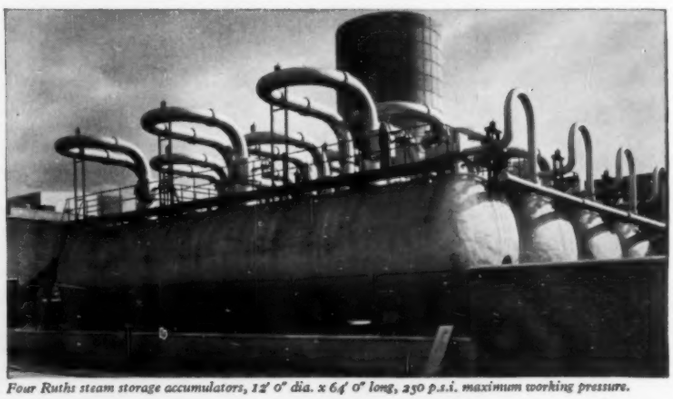
Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
France:				
Compagnie Francaise de Raffinage	La Mede [1]	130,000	SAC	13,300TC
	Gonfreville [2]	75,000	Comp.	35,400TC
Compagnie de Raffinage Shell-Berre	Petit-Couronne [3]	50,000	Comp.	12,500C
	Pauillac	16,500	SA	—
	Berre [4]	75,000	Comp.	15,700C
Pechelbronn S.A.E.M.	Merkwiller	4,200	SAL	—
Antar Petroles de l'Atlantique Caltex S.A.F.	Donges [5]	34,000	Comp.	19,200C
	Ambes [6]	23,000	SC	5,300C
Societe Francaise des Petroles B.P.	Lavera [7]	84,000	S	—
	Dunkerque [8]	52,000		
Mobil Oil Francaise	Notre-Dame de Gravenchon [9]	17,000	Comp. SL	—
	Frontignan [10]	26,000	SC	11,700C
Esso-Standard S.A.F.	Port-Jerome [11]	85,000	Comp.	20,900C
	La Mailleraye [12]	770	L	—
	Ambes [13]	—		—

[1] 17,000 b/d thermal reforming; 2,000 b/d thermal cracking capacity; 11,200 b/d catalytic cracking capacity.
[2] 10,700 b/d thermal reforming; 8,600 b/d thermal cracking; 27,900 b/d catalytic cracking, ethylene plant building to produce 30,000 t/y, completion Feb. 1959.
[3] 8,500 b/d thermal reforming; 12,500 b/d catalytic cracking. 11,000 b/d Hydrodesulfurizer building 13,000 b/d cat reformer projected completion late 1959; New distillation unit 80,000 b/d replacing old unit under construction. Net increase 39,000 b/d mid 1958 completion.
[4] 11,000 b/d thermal reforming; 4,700 b/d visbreaking; 11,000 b/d catalytic cracking.
[5] 11,000 b/d catalytic reforming; 19,200 b/d catalytic cracking.
[6] 4,000 b/d thermal reforming capacity 600 b/d cat poly.
[7] 4,400 b/d thermal reforming; 5,000 b/d catalytic reforming.
[8] 7,000 b/d thermal reforming. Under construction, 10,000 b/d catalytic reforming unit completion late 1958.
[9] 2,300 b/d thermal reforming; 3,400 b/d catalytic reforming; 5,000 b/d cat hydrodesulfurizer..

STEAM at a rate of ONE MILLION POUNDS PER HOUR



Three 9' 6" dia. Cochran Sinuflo Economic boilers having a total oil-fired duty of 38,000 lbs. of steam per hour at 250 p.s.i.



Four Ruths steam storage accumulators, 12' 0" dia. x 64' 0" long, 250 p.s.i. maximum working pressure.

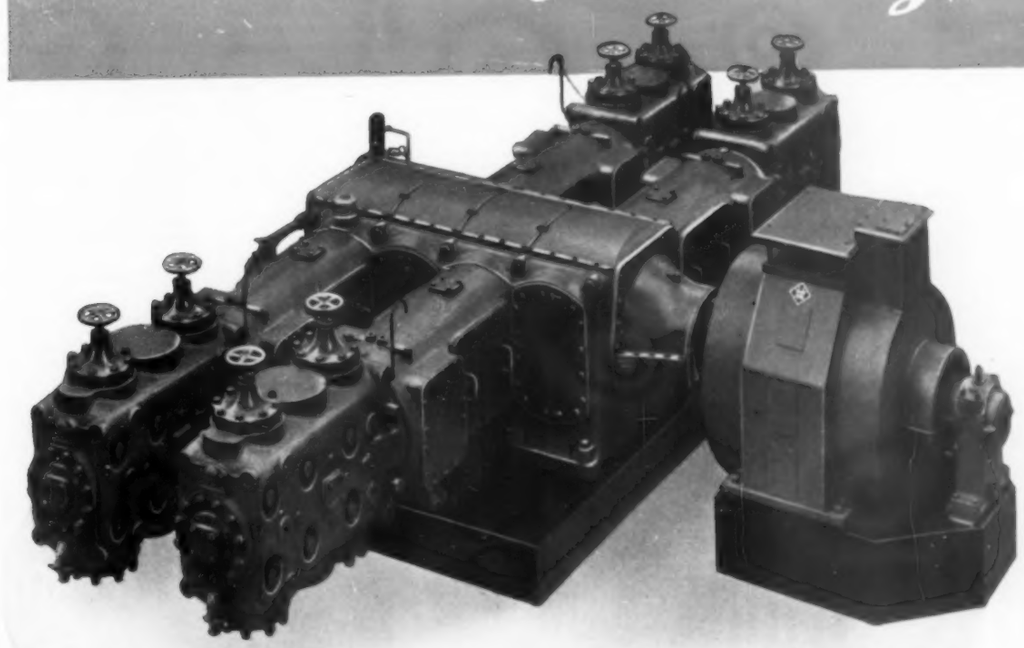
Steam at the rate of one million pounds per hour is supplied for test purposes at the works of Bristol Aero-Engines Limited by Sinuflo Economic boilers and Ruths steam accumulators made by Cochran & Co., Annan, Ltd. At this high rate of steam flow, no pressure drop is reflected back to the boilers and no change is necessary in the boiler firing rate. Similar plants, usually much smaller, are applicable to any steam-using industry where severe fluctuations in steam demand present a problem.

SINUFLO ECONOMIC **COCHRAN BOILERS** RUTHS ACCUMULATORS

Cochran & Co., Annan, Ltd., Annan, Dumfriesshire, Scotland and at 34, Victoria Street, London, S.W.1

TAS/CH.614

FM4 *Compactness and Economy*



Exceptional Compactness, together with Low Overall Operating and Maintenance Costs, are outstanding features of all H & W-Cooper-Bessemer type Compressors.

The FM4 type single-stage Compressor shown above, coupled to an H&W synchronous motor, has non-lubricated cylinders and is designed for Oil Refinery operation or Petro-chemical duties, compressing gases up to 1,000 lbs. per sq. in.

JM, FM and EM type compressors can be supplied for heavy duty motor, turbine or engine-driven service with pressures up to 25,000 lbs. per sq. in.

HARLAND & WOLFF
COOPER BESSEMER

H&W-COOPER-BESSEMER *Compressors*

HARLAND & WOLFF
LIMITED

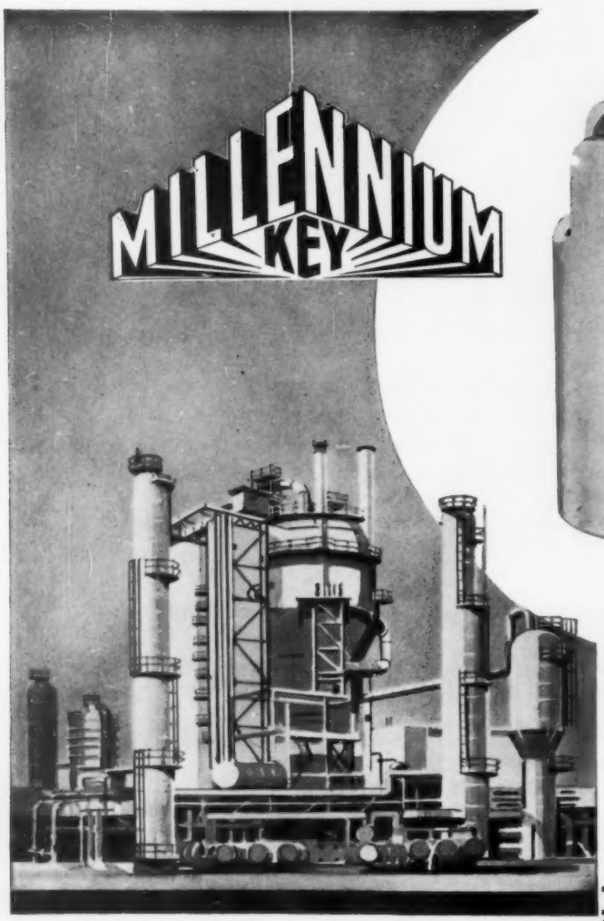
Engineering Works: Queen's Island, Belfast.
London Office: 9, Whitehall, S.W.1.

L.348

[10] 2,000 b/d thermal reforming; building cat reformer and cat hydrodesulfurizer for 1959 completion.
[11] 11,900 b/d thermal reforming; 20,900 b/d catalytic cracking. Under construction: powerforming unit, tetrapropylbenzene unit, gas-oil desulfurization unit.
[12] Medicinal and technical white-oil greases and special products.
[13] Under construction (distillation unit, catalytic reforming unit, gas unit, asphalt unit). Pipeline Parentis-Ambes achieved.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Germany:				
Badische Anilin-und Sodafabrik AG.	Ludwigshafen-on-Rhine [1]	1,000	SL	—
BP Benzin und Petroleum AG. (British Petroleum Co. Ltd.)	Hamburg-Finkenwerder [2]	40,000	SCA	4,500T
Deutsche Erdoel-AG.	Heide [3]	15,000	Comp.	7,000C
	Wietze	1,000	S	—
	Hamburg-Grasbrook [4]	1,600	L	—
Deutsche Shell AG.	Hamburg-Harburg [5]	19,000	Comp.	—
	Monheim/Reisholz	5,000	SAL	—
	Hamburg-Grasbrook [4]	640	L	—
Esso AG.	Hamburg-Harburg [6]	53,000	Comp.	11,500C
Gelsenberg Benzin AG.	Gelsenkirchen [7]	67,000	SCH	10,000C
Gewerkschaft Deurag-Nerag	Misburg nr. Hanover	17,000	Comp.	5,500T
Gewerkschaft Erdoel-Raffinerie Emsland	Lingen in Emsland [8]	17,000	SC	18,000C
Gewerkschaft Greiff Bergbau	Dollbergen	500	S	—
Johann Haltermann	Hamburg-Wilhelmsburg [4]	2,000		—
Kraftstoff-Handelsgesellschaft GmbH.	Essen	1,700	S	—
Mineraloel-und Asphaltwerke AG. (MAWAG)	Ostermoor on Kiel Canal	3,200	SA	—
Mineraloelwerke Peine (Schindler)	Peine (Hanover)	400	S	—
Mineraloelwerke Albert Sengewald	Dedenhausen	900	S	—
Mobil Oil AG. in Deutschland	Bremen-Oslebschausen [10]	16,000	Comp.	8,000C
Oelwerke Julius Schindler GmbH.	Hamburg-Neuhof	4,700	SLA	—
Rhurbau Mineraloelraffinerie GmbH.	Muelheim on Ruhr	6,500	S	—
Ruhrchemie AG.	Oberhausen-Holten [11]	8,000	SC	5,500TC
Ruhroel GmbH.	Bottrop [12]	2,600	S	—
Shcolven-Chemie AG	Gelsenkirchen-Buer [13]	21,500	SCH	5,100C
Union Rheinische Braunkohlen Kraftstoff AG.	Wesseling nr. Cologne [14]	42,000	SCH	11,700T
Wintershall AG.	Salzbergen in Emsland	2,100	SL	—
Zeller & Gmelin	Eislingen in Wuertemberg	170	S	—

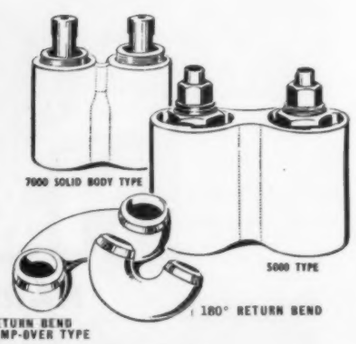
[1] Shut down.
[2] 5,300 b/d catalytic reforming; 3,200 b/d thermal reforming; building 6,000 b/d hydrofiner completion Dec. 1958.
[3] 4,000 b/d catalytic reforming; 2,500 b/d cat poly; building 2,500 b/d topping unit, 8,000 b/d hydrotreating, 20 t/d Claus unit, completion Oct. 1958.
[4] Half finished charging capacity.
[5] 2,300 b/d catalytic reforming. (Deutsche Shell is building 150,000 b/d refinery at Godorf near Cologne.)
[6] 6,500 b/d catalytic reforming capacity. (Esso is building 160,000 b/d refinery at Cologne.)
[7] 19,000 b/d catalytic reforming; 530 b/d cat poly; 9,200 b/d high pressure hydrogenation.
[8] 2,500 b/d catalytic reforming capacity.
[9] 2,800 b/d catalytic reforming capacity, crude capacity to be increased to 53,000 b/d.
[10] 3,700 b/d catalytic reforming, 5,000 b/d hydrodesulfurizer; crude capacity to be increased to 30,000 b/d.
[11] 1,800 b/d catalytic reforming.
[12] 800 b/d thermal reforming capacity.
[13] 2,100 b/d catalytic reforming capacity.
[14] 5,600 b/d catalytic reforming capacity and 4,700 b/d thermal reforming capacity.



1900 OR BOX TYPE

highest quality fittings for refinery and chemical plants

Please write for bulletins which give full technical information on each type of fitting.



Lake & Elliot Ltd.
BRAINTREE · ENGLAND

In 1836, Baron Berzelius looked to the Greeks for a word to describe the phenomenon whereby certain substances, merely by their presence, alter the rate of chemical reactions. He chose 'catalysis' from the Greek for 'down' (kata) and 'to loosen' (lyein) —the implication being that a catalyst alters the rate of reaction by loosening or breaking down the bonds of the reactant molecules.

In modern industry, many chemical processes are accelerated by catalysts. And in the heavy chemical, petroleum chemical, and petroleum refining industries, the I.C.I. range of catalysts is well known and widely used.

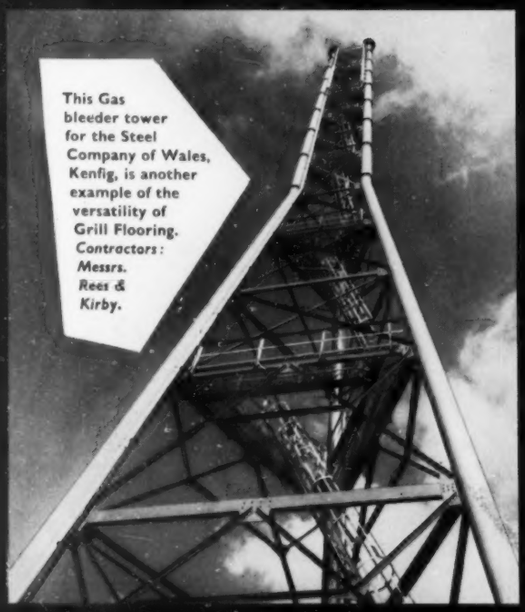
Full information on **I.C.I. CATALYSTS** *is available on request.*

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1.

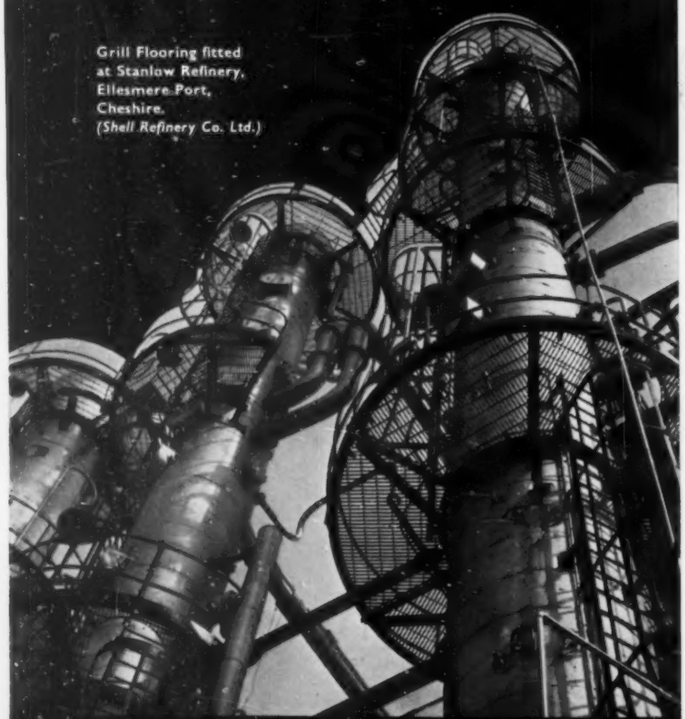
B.264

Grill Floors

Low weight and high strength combined with non-slip cleanliness are features which make these the perfect flooring for process plants, towers, factories, etc.



This Gas bleeder tower for the Steel Company of Wales, Kenfig, is another example of the versatility of Grill Flooring. *Contractors: Messrs. Rees & Kirby.*



Grill Flooring fitted at Stanlow Refinery, Ellesmere Port, Cheshire. *(Shell Refinery Co. Ltd.)*

GRILL FLOORS LTD

WEST ROW · NORTH KENSINGTON · LONDON · W10

Grams: ETYLADEC WESPHONE LONDON

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Greece:				
Greek Government	Aspropyrgos	27,000	S	[2]

[1] Leased to Greek-American company.
[2] Operator Hydrocarbon Research, Inc.

Hawaiian Islands:				
Pacific Refineries Ltd.	Honolulu, Oahu [1]	3,000	SA	—

[1] Operates on reduced crude butane.

Hungary:

Note: 5 refineries in operation in Hungary processed 34,000 b/d of crude in 1957. Locations: Almasfuezitoe, Csepel, Szoeny, Petfuerdoe and Zalaegerszeg.

Indonesia:				
N.V. de Bataafsche Petroleum Mij (Shell)	Balik Papan, N.E. Borneo	65,000	SW	—
	Paladju, Sumatra [1]	100,000	SC	20,000T
	Tjepu, Java	4,600	S	—
	Wonokroma, Java	3,200	SA	—
N.V. Standard-Vacuum Petroleum Mij.	Sungi, Gerong [2]	70,000	SCW	54,000TC

[1] 15,000 b/d thermal reforming capacity.
[2] 1,250 b/d cat poly, 750 b/d alkylation, 34,000 b/d thermal cracking, 20,000 b/d cat cracking.

India:				
Assam Oil Co.	Digboi	8,400	Comp.	1,900T
Burmah Shell Refineries	Bombay [1]	50,000	SCA	12,000C
Standard Vacuum Co. of India	Bombay [2]	32,000	Comp.	7,700
Caltex Oil Refining (India) Ltd.	Vishaktman	14,100	S	8,000C

[1] 6,700 b/d catalytic reformer, 7,300 b/d Edeleanu plant.
[2] 3,800 b/d thermal reforming, 250 b/d cat poly.

Iran:				
Iranian Oil Refining Co.	Abadan [1]	400,000	Comp.	27,000C
National Iranian Oil Co.	Masjid-i-Salaiman	12,000	T	—
	Kerminshah	3,000	S	—

[1] 75,000 b/d thermal reforming capacity.

Iraq:				
Kanaquin Oil Co. Ltd.	Alwand	11,000	S	—
	Basrah	3,430	S	—
Government Oil Refineries	Baghdad [1]	30,000	Comp.	18,000T
	Qaiyarah	1,200	A	—

[1] Thermal reforming 8,000 b/d; visbreaking 10,000 b/d, lube plant 25,000 t/y; cat. cracker planned; capacity of plant to be increased to 48,000 b/d and 5,000 b/d cat reformer to be installed.

Israel:				
Consolidated Refineries Ltd.	Haifa, Israel [1]	87,000	SA	23,500T

[1] 20,000 b/d thermal reforming.

Italy:				
Anonima Petroli Italiana	Falconara [1]	26,000	S	8,000T
A.B.C.D.	Ragusa, Sicily	100	A	—
AGIP—Mineraria	Cortemaggiore	2,965	SC	2,225C
Aquila	Trieste	26,000	Comp.	6,300C
Bianchi Petroli	Cologno Monzese	1,500	S	—
Condor	Rho [2]	45,000	SC	15,000C
Delle Piane	Genoa	1,000	S	—
D.I.C.A.	Carrara	8,800	S	—
Garrone	Genoa [3]	29,000	S	—
Golfo	Gaeta [4]	20,000	S	—
I.R.O.M.	Marghera, Venice [5]	35,000	Comp.	—
IPLOM	Busalla, Genoa	4,000	S	—
I.C.I.P.	Mantua [6]	12,000	SC	2,340C
I.L.S.E.A.	Valmadrera, Como [7]	2,700	S	—
Italia	Cremona	25,000	S	—
INPET-Shell	La Spezia [8]	35,000	SLA	—
NILO	Milan [9]	10,000	S	—
Lombarda Petroli	Villasante, Milan	5,500	S	—
Purfina Italiana	Genoa [10]	11,000	Comp.	1,500C
	Milan [11]	7,000	SLA	—
	Rome [12]	11,000	Comp.	1,500C
Petroli d' Italia	Fiorenzuola d'Arda, Parma	4,000	SC	1,000T
RASIOM	Augusta, Sicily [13]	95,000	S	—
R.O.L.	Viguzzolo, Alessandria	1,400	SL	—
Mobil	Naples [14]	65,000	Comp.	13,500C
Sanquirico	Genoa	4,000	S	—

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
SAROM	Ravenna [15]	48,000	SC	5,000T
SARPOM	Trecate, Novara [16]	25,000	SC	4,300C
SARN	Novara [17]	1,500	SLA	—
S.P.I.	Fornovo, Parma [18]	2,200	S	—
Stanic	Bari [19]	47,000	S	—
	Leghorn [20]	50,000	SLA	—
Standard-ESSO	Trieste	6,100	S	—
STOI	Florence [21]	15,000	S	—
Volpato	Milan	2,100	S	—

[1] 3,00 b/d thermal reforming; cat. reformer under construction.
[2] 5,500 b/d Platforming; hydrodesulfurization 6,000 b/d.
[3] 5,000 b/d cat. reforming, 1,800 b/d thermal reforming.
[4] 3,000 b/d Platforming.
[5] 6,600 b/d thermal reforming; 2,000 b/d Platforming; 1,650 b/d cat. poly.
[6] Revamping visbreaker to 8,000 b/d topping. Cat. reforming 2,340 b/d.
[7] 500 b/d cat. reforming.
[8] 3,000 b/d thermal reforming capacity; 6,700 b/d cat. reforming.
[9] 1,100 b/d reforming. Platformer and desulfurization units planned.
[10] 1,500 b/d cat. reforming.
[11] 500 b/d reforming, 3,000 b/d vacuum dist.
[12] 500 b/d reforming. Refinery to be dismantled and completely rebuilt near Fregene, Rome.
[13] 5,000 b/d cat. reforming.
[14] 10,000 b/d cat. reforming and 11,000 b/d hydrodesulfurization building and MEK plant expanding, completion late 1958; TCC unit to be converted to crude processing 1959.
[15] 2,000 b/d thermal reforming; 4,000 b/d cat. reforming; 1,400 b/d gasoil desulfurizer under construction.
[16] 3.750 b/d thermal reforming, 400 b/d cat. poly.
[17] Refinery dismantled. Plant being moved to Gela, Sicily, to process to asphalt heavy crude from Gela oilfield of AGIP-Mineraria.
[18] 3,000 b/d cat. reforming.
[19] 6,000 b/d cat. reforming.
[20] 6.000 b/d cat. reforming.
[21] Refinery being completely renovated.

Note: Two new refineries are planned in Sicily; Soc. Mediterranea at Milazzo (Messina) 50,000 b/d; ISLOM at Palermo 8,000 b/d.

Jamaica:

Government and Jamaica Oil & Chemical will build new 20,000 b/d refinery to be completed in 1960.

Japan:

Asia Oil Company	Yokohama	13,000	SLA	—
Daikyo Oil Company	Yokkaichi [4]	25,000	Comp.	3,500C
Idemitsu Kosan K.K.	Tokuyama	35,000	Comp.	7,000C
Kita-Nippon Oil Company	Hakodate [7]	12,000	S	—
Koa Oil Company	Marifu [5]	37,000	Comp.	2,500T
Maruzen Oil Company	Shimotsu	37,500	Comp.	3,000C
	Matsuyama [5]	10,000	S	—
Mitsubishi Oil Company	Kawasaki	55,260	Comp.	2,700T
Nippon Mining Company	Funakawa	15,300	Comp.	—
Nippon Oil Company	Akita	4,000	Comp.	1,000T
	Niigata [4]	7,500	Comp.	—
	Kashiwazaki	1,500	SL	—
Nippon Petroleum Refining Co.	Kudamatsu [9]	25,000	Comp.	—
	Yokohama [1]	42,000	Comp.	5,150C
	Muroran	10,000	S	—
Showa Oil Company	Kawasaki	27,000	Comp.	—
	Niigata	11,000	Comp.	—
	Hirasawa	3,000	Comp.	—
Showa Yokkaichi Oil Co.	Yokkaichi [2]	40,000	S	—
Taiyo Oil Company	Kameoka	5,000	SLA	—
Toa Nenryo Kogyo K.K.	Shimizu [2]	32,000	SL	—
	Wakayama	43,500	Comp.	18,000C
Toa Oil Company	Kawasaki	12,000	S	—

[1] 3,000 b/d Platformer and Unifiner completed March 1958; furfural unit building.
[2] 4,600 b/d cat reformer and hydrofiner under construction; complete Sept. 1958.
[3] Shell type 12,000 b/d fluid cat. cracker; complete July, 1958.
[4] 1,600 b/d Platformer under construction: complete August, 1958.
[5] 3,000 b/d Platformer, 25,000 b/d topping plant and Udex unit planned.
[6] 30,000 b/sd topping plant to be completed late 1958, 218 b/d thermal reformer, a 3,000 b/d Houdriformer completed April, 1958.
[7] 1,500 b/sd Platformer planned.
[8] 3,000 b/d Platforming.
[9] 1,500 b/d cat reformer, to build added catalytic processing in 1959.
[10] 3,850 b/d cat reforming.

Jordan:

Jordanian Refinery Co. is planning construction of a 6,600 b/d refinery for completion in 1960.

Kuwait:

Kuwait Oil Co. Ltd.	Mina al Ahmadi, Persian Gulf [3]	190,000	S	—

[3] 4,000 b/d Platformer.

VOKES N.C.

Exhaust Silencers

Here is an entirely new Vokes development—the N.C. exhaust silencer. Designed originally for marine use, it is now also available for commercial vehicles and large stationary diesel applications. Offering high efficiency with greatly reduced size, the Vokes N.C. Silencer makes use of the Reflection or Detuning principle. The low back pressure of the N.C. Silencer makes no demand on engine power and lengthens the time between exhaust system clean outs. Of all-steel welded construction, N.C. Silencers have flanges to British Standard Table 'D'. Drain cocks are provided in each chamber and inspection doors allow easy access for cleaning. Please write for further details.

Features of the Vokes N.C. Exhaust Silencer:

★ Minimum space requirement.
★ No demand on engine power.
★ Longer periods between exhaust clean out.
★ All steel welded construction.
★ Inspection doors for easy cleaning.

A large marine type N.C. Exhaust S lencer.

VOKES

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V272

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Lebanon:				
Iraq Petroleum Co. Ltd.	Tripoli	11,500	S	—
Mediterranean Refining Co.	Sidon (1)	9,000	S	—

(1) 1,200 b/d Platformer.

Mexico:				
Petroleos Mexicanos	Arbol Grande, Tampico	26,000	SAL	—
	Altzacapoltzalco, D.F. (1)	100,000	SCA	14,500T
Petroleos Mexicanos	Ciudad Madero, Tampico (2)	75,000	SCA	6,000T
	Mata Redonda, Vera Cruz (6)	14,000	SC	6,000T
	Minatitlan, Vera Cruz (3)	50,000	SC	15,000C
	Poza Rica, Vera Cruz (7)	7,000	S	—
	Reynosa, Tampico (4)	7,000	S	—
	Salamanca, Gto (5)	40,000	Comp.	5,000T

(1) 30,000 b/d vacuum unit, 25,000 b/d cat. cracker, 3,000 b/d alkylation unit and 800 b/d cat poly unit under construction.
(2) 12,000 b/d cat. reforming capacity. Crude capacity to be increased to 102,000 b/d, a cat. cracker, alkylation, polymerization and coking units under construction.
(3) 800 b/d lube plant under construction; complete 1958.
(4) 10,000 b/d additional distillation capacity and a 2,200 b/d thermal cracking unit planned for construction.
(5) 15,000 b/d cat. cracker and grease plant planned.
(6) Crude capacity increase of 20,000 b/d planned, completion 1960.
(7) In connection with 90,000 b/d crude stabilizer.

Morocco:				
Soc. Cherifienne des Petroles	Petitjean	2,400	SC	1,400C

Neutral Zone:				
Getty Oil Co. (1)	Mina Saud	50,000	S	—

Note: Plant may be operated as crude stabilizer or topping unit or partly for each purpose.
Note: American Independent Oil Co. is building a 30,000 b/d plant at Mina Abdulla, 4th quarter 1958 completion.

Netherlands:				
N.V. de Bataafsche Petroleum Mij (Shell)	Pernis (1)	300,000	Comp.	86,000TC
Caltex Petroleum Mij N.V.	Pernis (2)	46,000	SC	9,000T

(1) 10,000 b/d thermal reforming, 20,000 b/d thermal cracking and 66,000 b/d cat. cracking. Cat. reformer 12,700 b/d; two hydrodesulfurizers, 16,400 b/d and 7,800 b/d under construction complete 3rd quarter 1958. Alkylation plant 2,800 b/d.
(2) 7,000 b/d thermal reforming, 7,000 b/d Platformer and Unifiner, 950 b/d cat. poly.

Netherlands West Indies:				
N.V. Curacaosche Petroleum Industrie Mij	Curacao (1)	210,000	Comp.	120,000TC
Lago Oil & Transport Co.	Aruba (2)	440,000	Comp.	93,000TC

(1) 20,000 thermal reforming capacity.
(2) 16,000 b/d thermal reforming, 50,000 b/d thermal cracking; 43,000 b/d cat. cracking, 5,000 b/d alkylation, 340,000 b/d visbreaking (includes thermal reforming and cracking).

Norway:				
A/S Norske Esso (A/S Ostlandske Petroleum-Compagni)	Valloy per Tonsberg	2,100	SLA	—

Pakistan:				
Attock Oil Co.	Punjab, Rawahlpindi	7,500	S	—

Panama:

Two refineries planned for construction. Panama Refining Co. is planning a 70,000 b/d plant for late 1961 completion. Panama Refining & Petrochemical Co. is planning a 55,000 b/d plant now under design.

Full speed ahead for 35 . . .

This is a 32 ft. general purpose light alloy launch with accommodation for 35 passengers—one of a number on delivery to The Shell-B.P. Petroleum Development Company of Nigeria Limited. She's powered by a Perkins S.6 Diesel engine and designed for fast, reliable transport of Marine personnel *especially in tropical areas.*

Built on our patented "Two-way-tension" system of construction, this class of launch has exceptional strength and ruggedness. Ease of maintenance and economical running are additional advantages; and the light alloy hull is immune to teredo worm attack, rust, wet and dry rot, or deterioration in extreme climatic conditions.

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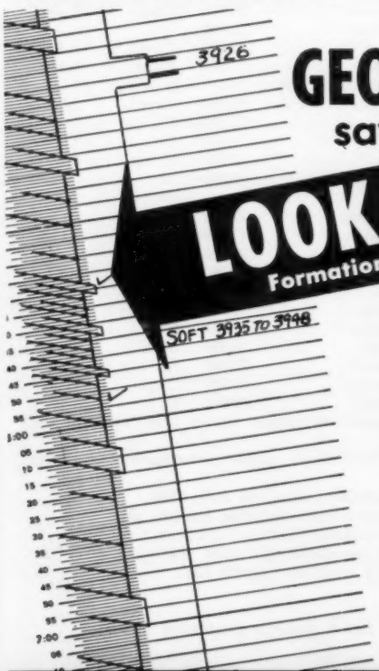
AP20

FORMATION CHANGES?



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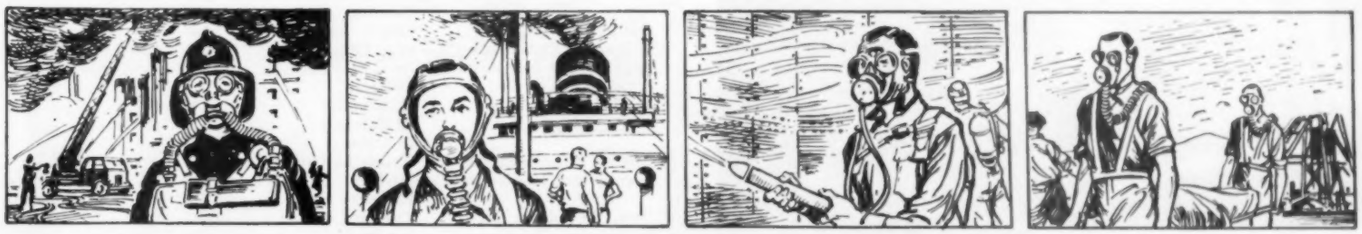
Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Peru:				
Cia. de Petroleo Ganso Azul	Agua Caliente	1,000	S	—
Empresa Petrolera Fiscal	Iquitos	1,500	S	—
International Petroleum Co.	Talara	43,500	Comp.	14,500T
Philippine Islands:				
Caltex (Philippines) Inc.	Batangas	13,000	SC	5,400C
Note: Standard Vacuum Oil Co. has been given permission to build a refinery on the Bataan peninsula. Projected plant will have capacity of 25,000 b/d. Completion 1961.				
Poland:				
Refineries at Czechowice, Glinik-Mariampolski, Jaslo, Jedlicze and Trzebinia processed 15,000 b/d of crude in 1957. A 40,000 b/d plant is to be built at Konin for completion in 1963.				
Portugal:				
"Sacor" S.A. Concessionaria de Refinacao de Petroles em Portugal	Cabo Ruivo	27,000	SLA	10,000C
Puerto Rico:				
Caribbean Ref. Co.	San Juan	10,500	SC	5,000C
Commonwealth Oil Ref. Co.	Quayanella Bay (1)	55,000	SC	27,000C
(1) 6,500 b/d cat. reformer, 1,540 cat poly unit, 2,400 b/d alkylation unit. Major expansion planned for 1959 includes 20,000 b/d visbreaker, crude capacity increase to 75,000 b/d, desulfurizer.				
Qatar:				
Qatar Petroleum Co. Ltd.	Umm Said	600	S	—
Romania:				
Current capacity of Romanian refineries is estimated at 230,000 b/d. In 1957 a new thermal cracker and atmospheric distillation unit were completed at Borzesti.				

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Saudi Arabia:				
Arabian American Oil Co.	Ras Tanura (1)	189,000	Comp.	—
(1) 25,500 b/d thermal reforming, 13,700 b/d Hydroformer, 13,500 b/d desulfurization unit, 1,000 cat-poly, 1,210 b/d alkylation unit under construction, to be completed 1959.				
South Africa:				
So. Africa Torbanite Mining Boksburg N. & Refining Co.	Transvaal	2,000	SAC	2,000T
Standard Vacuum Refining Co. of So. Africa Pty. Ltd.	Durban (1)	21,000	Comp.	10,000C
(1) 2,000 b/d thermal reforming, 250 b/d cat poly.				
Note: Shell Co. of South Africa is discussing with the government construction of 80,000 b/d refinery adjacent to Durban Bay.				
Spain:				
"Campsa" Coa. Arrandetaria del Monopolio de Petroleo S.A.	Barcelona	700	S	—
"Cepsa" Cia Espanola de Petroleo S.A.	Canary Islands (1)	70,000	Comp.	3,500T
Refineria de Petroles de Escombreras, S.A.	Escombreras (2)	80,000	SL	—
(1) 5,000 b/sd Platforming, with Udex unit, 3,000 b/d thermal reforming, 5,000 b/d Edeleanu plant planned.				
(2) 9,000 b/d thermal reforming, 11,000 b/sd Platformer, 460 b/sd cat poly.				
Sweden:				
A-B-Nymas Petroleum	Nynasham (1)	14,000	Comp.	1,000T
	Malmo	1,900	SA	—
	Gothenburg	2,900	S	—
Koppartrans Oljeaktiebolag	Goteburg (2)	30,000	S	—
Svenska Skifferoje A/B	Narkes-Kvarntorp (3)	2,000	S	—
(1) 1,900 b/d thermal reforming, 35,000 b/d capacity increase and 6,850 b/d Platformer under construction.				
(2) 4,500 b/d thermal reforming and 5,500 catalytic reforming.				
(3) Shale oil plant under construction: Ammonia plant, Hydrofiner and Hydroformer for gasolines.				

Whatever the hazard . . .



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Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Switzerland:				
A.G.	Rotkreuz [1]	1,500	S	—
Schweiz-Sprengstoffabrick	Dottikon [2]	350	S	—

[1] Operates on tops.
[2] Manufactures special naphthas.

Turkey:				
Turkey Petrolleri A.O.	Batman [1]	6,250	SCA	3,580C

Note: The government has authorized the construction of a 15,000 b/d refinery Istanbul by Turkish American Oil Co. A consortium composed of Shell, Cal-Tex., British Petroleum and Socony Mobil has projected a 65,000 b/d plant for 1961 completion.
[1] TCC unit to be revamped in 1959.

Trinidad:				
Brighton Terminal Ltd.	Brighton	5,000	S	—
Shell Trinidad Ltd.	Point Fortin	37,000	SA	—
Texaco Trinidad Inc.	Point-a-Pierre [1]	100,000	SCA	54,500TC

[1] 36,000 b/d visbreaking and 26,500 b/d cat. cracking, 5,000 b/d thermal reforming, 1,400 b/d cat. poly 8,000 b/d platformer. 10,000 b/d hydrotreater under construction.

United Kingdom:				
BP Refinery (Kent) Ltd.	Isle of Grain, Kent [1]	180,000	SCL	12,500C
BP Refinery (Grangemouth) Ltd.	Grangemouth [10]	45,000	SC	12,500C
BP Refinery (Llandarchy) Ltd.	Llandarchy S. Wales	62,000	Comp.	12,500C
Berry Wiggins & Co. Ltd.	Kingsmouth on the Medway nr Rochester, Kent	3,200	S	—
	Weaste [2]	1,900	S	—
Briggs & Co. Ltd. Wm.	Dundee, Scotland	1,000	SLA	—
Carless Capel & Leonard	London	300	S	—
Esso Petroleum Co. Ltd.	Fawley [3]	228,100	Comp.	44,300C
Lobitos Oil Fields Ltd.	Ellesmere Port [4]	3,700	Comp.	800T
London & Thamshave Oil Wharves Ltd.	Thameshaven	2,000	LA	—
Manchester Oil Refinery Ltd.	Trafford Park [5]	3,500	Comp.	—
Scottish Oils Ltd.	Pumpherston, Scot.	3,500	SC	2,800T
Shell Refining & Marketing Co. Ltd.	Stanlow, Ellesmere Port [6]	100,000	Comp.	33,000C
Shell Refining & Marketing Co. Ltd.	Shell Haven, Essex [7]	75,000	Comp.	—
	Heysham, Lancs. [8]	36,000	SC	6,000T
Starhaven Refineries Ltd.	Ardrossan, Scot.	3,200	S	—
Mobil Oil Co. Ltd.	Coryton, Essex [9]	30,000	Comp.	9,500C

[1] 6,000 b/d Platforming, 10,000 b/d hydrofining building, 10,000 b/d cat reformer, 12,000 b/d thermal reformer; 10,000 b/d Hydrofiner, 2,250 alkylation unit, 45 t/d sulfur recovery unit.
[2] A 1,620 b/d two stage distillation unit under construction.
[3] 10,000 b/d Hydroforming capacity. Hydrofiner Steam cracker and butene dehydrogenation unit, complete mid-1958.
[4] 800 b/d Platformer.
[5] To double output of sulfonates in 1958.
[6] 13,000 b/d thermal reforming, 9,000 b/d Platforming.
[7] 10,000 b/d thermal reforming, 6,700 b/d Platforming, 80,000 b/d crude unit building, complete 3rd quarter 1958, 16,000 b/d hydrodesulfurizer projected for 1960.
[8] 4,000 b/d thermal reforming, 6,000 b/d visbreaking.
[9] 6,000 b/d catalytic reforming.
[10] Existing crude unit to be replaced by new 65,000 b/d still, completion 1959

Uruguay:				
Administration Nacional de Combustibles, Alcohol y Portland (ANCAP)	Montevideo [1]	28,000	SCA	7,000T

[1] 5,000 b/d catalytic cracking, 3,000 thermal cracking building, 24,000 b/d crude still to provide net capacity increase of 17,000 b/d, 7,000 b/sd cat cracker, 3,000 b/sd cat reformer, converting thermal cracker to visbreaking.

USSR:

Capacity of Soviet refineries is estimated at 1,950,000 b/d of which about 650,000 b/d is in the Caspian-Black Sea area and about 900,000 b/d in the so-called second Baku region near the Urals. A new refinery at Stalingrad was activated in February 1958. Cracking capacity has been estimated at 600,000 b/d. Crude runs increased 21% in 1957 and an additional increase of 12% is planned for 1958. New refinery construction has been completed at Omsk, Krasnoyarsk, Gorkiy, Perm and Stalingrad. Government plans are to increase capacity by 200,000 to 240,000 b/d by 1960.

Venezuela:				
Cia. Shell de Venezuela Ltd.	San Lorenzo	45,000	S	—
	Cardon [2]	203,000	SCL	63,000TC
Creole Petroleum Corp.	Amuay Bay [1]	328,000	S	—
	Caripito	60,000	SC	35,000T
Phillips Oil Co.	San Roque [5]	3,000	S	—
Richmond Exploration Co.	Bajo Grande [4]	45,000	SA	—
Shell: Colon Development Co. Ltd.	Casigua	1,000	S	—
	La Rivera	300	S	—
	El Calvario	300	S	—
	El Cubo	570	S	—
Sinclair Oil & Refining Co.	Puerto La Cruz	35,000	S	—
Socony Mobil de Venezuela	Silvestre	200	S	—
	El Palito	[7]	[7]	[7]
Texas Petroleum Co.	Tucupita	10,000	S	—
Venezuelan Government	Moron [6]	3,000	Comp.	1,800T
Venezuela Gulf Refining Co.	Puerto La Cruz [3]	57,000	Comp.	18,660TC

[1] 11,000 b/d Hydroforming capacity; 700 b/d lube plant went into operation May 1958. 17,000 b/d Hydrofiner on stream January 1958.
[2] Includes new 35,000 b/d catalytic cracking capacity recently added. 25,000 thermal cracking capacity, 2,800 b/d alkylation plant. 80,000 b/d distillation unit under construction, to be completed 3rd quarter 1958.
[3] Includes 14,500 b/d visbreaker unit. Also has polyform unit. Fluid catalytic cracking unit is 8,660 b/d capacity; Thermal cracking unit 10,000 b/d.
[4] Consists of three distillation units. Unit 1 has 15,000 b/d capacity, Unit 2 has 10,000 b/d capacity, Unit 3 has 20,000 b/d capacity. Unit 2 to be expanded to 15,000 b/d by addition of heat exchangers and feed pumps. No. 3 to be raised to 23,000 b/d for production of topped crude and heavy fuel oils and 8,500 b/d asphalt. All additions to be completed during 1959.
[5] Consists of two separate plants at same location: including one 500 metric tons/month lube plant; one 3,000 b/d refinery which makes about 1,200 b/d of motor gasoline, also kerosine and diesel fuel. Gas stabilization unit is connected.
[6] A pilot plant with complete facilities for experimentation. A large refinery and a petrochemical complex have been under construction but plans are presently being restudied.
[7] 40,000 b/d plant to be constructed at El Palito terminus, about 8 miles from Puerto Cabello. Lube plant to be included. Facilities for production of high-octane gasoline to be included.

Yugoslavia:				
Government	Rijeka	7,300	Comp.	—
	Sisak	8,800	S	4,000C
	Bosanski Bros	6,600	SIC	2,400T

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Washington Pipeline

(*Continued from page 4*)

need not be charged against the producing property if the election to aggregate under section 614 (b) has not been exercised."

Long-Range Supply Study

Long-range demand and supply study by Interior, at request of Office of Defense Mobilization, of USA and the world could lead to major changes in government policy. Under Secretary Seaton's direction—with Office of Oil & Gas Carson in charge at working level—study aims include: supply and demand by 1965, 1970, and 1975, by areas of the world; USA product demand, wells (and cost) required to meet that demand in those years. Study will try to measure the impact upon the USA and Western Europe if oil from the Middle East is cut off in part or entirely, as well as from Far East, South America, and Canada.

Military Requirements Rise

Military Petroleum Advisory Board estimates oil requirements for fiscal year beginning July 1, 1958 —both for USA and overseas—at 260 million barrels. By mid-1959 gradual decrease should set in —with annual military demand by fiscal 1963 at 3% below 1959. But continuing rise in jet-fuel demand is foreseen; by 1963 it should be 50% over 1957. JP-5 jet-fuel demand will rise even higher— 2½ times during same period. MPSA contracts for oil products during 1957 amounted to $1,256,288,126.

Shale Facilities for Lease

The US government, which has about four million dollars worth of oil shale facilities at Rifle, Colo., is considering leasing them to private oil companies. Once legislation is enacted, according to W. B. Franke, Under Secretary of the Navy, "we will immediately call for bids" on plant facilities and the deposits of shale.

No Change for Elk Hills

The Navy is fighting efforts of three independent refiners on the West Coast to abandon contracts to buy crude oil from the Elk Hills Naval Petroleum Reserve. The three are Douglas, Mohawk, and Rothschild. They signed a contract last year to buy in all 14,000 b/d from the reserve. Standard Oil Co. (Calif.) made an equal bid. Senator Joseph C. O'Mahoney (D., Wyo.,) urged the navy to give the crude to the smaller firms. Then, the price of crude dropped, with the opening of the Suez Canal.

Navy is opposing a bill by O'Mahoney to allow the companies to abandon the contracts or to renegotiate the price down to the current market level. Naval officers, claiming bill could cost USA one million dollars a year, are aided by a letter from Comptroller General Joseph Campbell. He saw no reason to cancel or change the contracts.

Keep Imports Voluntary

Oil men are still talking of the forthright address of Assistant Secretary of Commerce Frederick H. Mueller to the midyear meeting of the Independent Petroleum Assn. of America, April 28. Mr. Mueller, who has been handling oil import matters, defended the "voluntary" program as working. So, to start with, he was at odds with IPAA, which seeks a law for mandatory quotas on crude-oil imports.

Then, he said, natural-gas sales are rising, and suggested this might be named as the "villain" rather than oil imports, as USA crude production drops. He answered his own point saying gas "is a major area of the domestic oil industry." He warned that mandatory controls lead to price and production controls, where the government would "determine who sells what products to whom." This, he said, means "socialism." He added: "You men in the petroleum industry are known as rugged individualists. Mandatory controls are a phony rig for men enjoying such a birthright."

Mr. Mueller even moved very close to the area of price, as he said the free-enterprise system gives producers wide latitude in creating sufficient demand for their products. "You know," he said, "it just could be possible that your industry has overlooked some basic ways and means to this end."

Voluntary Program Works

The "voluntary" program to limit crude-oil imports, now that it has new "teeth," appears to be working. Captain M. V. Carson, Jr., oil imports administrator, says the two score or more oil importers are "bending every effort" to comply. Concrete result came when Tidewater Oil Co., which had been bringing as much as 60,000 b/d to 70,000 b/d to the East Coast, cut imports to 40,000 in March, and 18,900 in April, to comply. The cuts put the company in compliance with the assigned quota of 33,000 b/d, and Carson promptly issued a certificate of compliance. Without compliance, a company is barred from bidding on sales to the government.

At the US Capital, meanwhile, the fight rages over proposed legislation to tighten up the curbs on oil imports. Proposed is a law to limit imports of crude and products to the 1954 ratio. Final outcome won't be known, probably, until July.

Forecast USA Demand

Outlook is for the USA to consume 13 million barrels daily by 1975, less than 20 years hence. On this, both the Department of Defense and the Independent Petroleum Assn. of America agreed recently. On the supply side, they parted company Defense foresaw need for four to six million barrels daily of oil imports. Or else, it said, oil must come from USA shale-oil beds. IPAA, however, foresaw a USA producing capacity of more than 16 million barrels of crude by that time, at reasonable prices, or more than enough to meet the demands.

Refining Profits Drop

Oil refineries had larger sales but smaller profits in 1957, the Federal Trade Commission and Department of Commerce reported. Sales rose 9% to $27.1 billion; profits after taxes dropped 1% to $2.9 billion.

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Hydrodesulfurizer for Shell

Shell Oil Co. of Canada Ltd. will build a distillate hydrodesulfurizer at its Shellburn refinery, North Burnaby, British Columbia. A contract for the construction of the new unit has been awarded to the Fluor Corp. of Canada Ltd. Construction will be completed by February 1959.

Air and Gas Dehydration Bulletin

Davison Technical Bulletin 202, just issued, presents in text and graph form the latest information on air and gas dehydration with silica gel. Covered are natural-gas dehydration;· recovery of hydrocarbons from natural gas; compressed air dehydration; atmospheric dehumidification; dehydration of industrial gases; also fundamental characteristics of silica gel, special types, and other applications: From Davison Chemical Co., Baltimore 3, Md.

Indirect-fired Heater Bulletin

Prown Fintube Co., Elyria, Ohio, has published *Bulletin No. 587*, to give specifications and applications for Type 102 indirect-fired heaters for the petroleum and petrochemical industries. The heaters are designed for gases and vapors, light liquids, and heavy oils such as bunker "C." Operating temperatures range up to 1,000 F, and pressures to 300 psig; capacities run up to one million Btu's per hour.

Badger Contracts for Holland

Badger Comprimo NV (owned jointly by Badger Manufacturing Co. and Comprimo NV, The Hague), The Hague, has been awarded contracts totaling $2,800,000 for three chemical plants and an asphalt-production unit. The latter unit is for Esso Belgium, in further extension of large refinery expansion program started in 1957. Work on all four project is already under way.

Although less than two years old, Badger-Comprimo has now been awarded contracts totaling more than $50 million.

Canadian Oil Appointment

J. F. Kidner, C.A.

At a recent meeting of the Board of Directors of Canadian Oil Companies, Ltd., J. F. Kidner was appointed Treasurer of the company, effective June 1st. He succeeds C. W. Walker who retires after 45 years service.

Mr. Kidner was previously Comptroller of the company, a position he retains in his new capacity. He has been associated with Canadian Oil Companies, Ltd. for 27 years and has held successively important positions in accounting and financial administrative work. Mr. Kidner will continue to make his headquarters at Toronto.

Dr. R. E. Vener

T. H. Milliken, Jr.

Kellogg Appoints Vener

M. W. Kellogg Co. has appointed Dr. Raymond E. Vener manager of industrial research. He was a research scientist on the Manhattan Project and, after the war, a chemical engineering professor at Drexel Inst. For the past seven years he has been with Catalytic Construction Co.

Instruments to Sun Electric

Texas Instruments Inc., Dallas, Texas, has sold its panel-instruments manufacturing facilities and product line to Sun Electric Corp., Chicago

Kellogg Demonstrates for D & D

Desk and Derrick Club of New York, at its May 20 meeting, heard Arthur L. Dowling, director of public relations and advertising for M. W. Kellogg Co., speak on "Engineering and Construction Petroleum Refineries." A 12-min motion picture, illustrating tasks assigned engineering-construction firms by petroleum organizations, was shown. Mr. Dowling outlined roles played by women in engineering and construction companies.

W. Clark Root Heads Graver

W. Clark Root has been elected president and chief executive officer of Graver Tank Manufacturing Co., East Chicago, Ind. He succeeds Jalmer E. Swason, who becomes vice chairman. Edward N. Gosselin is chairman.

Mr. Root joined Graver Tank in April 1958, as executive vice president. Previously he was project manager for Canadian Bechtel Ltd.

SBA-Kellogg Acetylene Process

A brochure describing the new SBA-Kellogg acetylene processes has just been published by The M. W. Kellogg Co., 711 Third Ave., New York 17. The brochure describes the processes developed originally by Ste. de l'Azote (SBA) of Belgium to produce high-purity acetylene from natural gas or from naphtha and other liquid feed stocks, now made available to the petroleum and petrochemical industries by collaboration between SBA and M. W. Kellogg.

Designs Para-Xylene Plant

Scientific Design Co. Inc. has been awarded a contract to design a para-xylene manufacturing plant for Mitsui Petrochemical Industries Ltd., of Tokyo. The plant will be constructed at Iwakuni City, Japan, and is scheduled to be completed by the summer of 1959. The new plant will be part of the large petrochemical complex Mitsui is now operating.

Badger Elects New Directors

Dr. James S. Carey and Mr. Philip H. Seaver have been elected directors of Badger Mfg. Co., Cambridge, Mass. Mr. Seaver has been a sales engineer with the company since 1951. The directors elected Anson W. Krickl a vice president. He will continue as manager of the manufacturing division.

Tanker-Loading Brochure

A new brochure describing the Chiksan hydraulically controlled marine loading arm is now available. Profusely illustrated and containing general specifications, *Bulletin No. 258* may be obtained by writing The Chiksan Co., Brea., Calif.

Kellogg Appoints Milliken

The M. W. Kellogg Co., subsidiary of Pullman Inc., has announced appointment of T. H. Milliken, Jr., as director of planning of the research and development department. He had been with the Sun Oil Co., and was formerly assistant director of research and head of the contract research division at the Houdry Process Corp.

TEL Valve Life Increased

Substitution of "Teflon" TFE-fluorocarbon resin for lead as the closure face in valves controlling the flow of tetraethyl lead not only has doubled value life at gasoline blending plants, but has sharply reduced maintenance costs and potential exposure to lead hazards, Du Pont's petroleum chemicals division reports. Tests conducted over the past few years, at widely scattered locations serviced by Du Pont, have shown such excellent results that the new type values have been adopted as standard.

Hortonclad Brochure

Chicago Bridge & Iron Co. has published a 32-page brochure describing the manufacture of Hortonclad, a composite metal produced by a flux-free high-strength bonding process which provides an integral and continuous bond between an alloy or special metal and its backing place.

Completes New Plant

Smithco Engineering Inc., manufacturers of air-cooled heat exchangers, has completed new manufacturing facilities at 602 W. 41st St., which will supplement the present plant and offices at 504 S. Trenton, Tulsa. A further expansion is scheduled for July 1959, when all departments will move to the new location.

Enlarges Houston Plant

Chicago Bridge & Iron Co., Chicago, has moved its Houston erection district facilities to new quarters on an 85-acre site northeast of that city. The facilities—including a warehouse, maintenance and field construction equipment, plate rolls, edge preparation equipment, and a crane runway—were formerly located on a three-acre tract on Clinton Drive.

Ansul Marine Models

Ansul Chemical Co. is introducing two new types of marine dry-chemical fire extinguishers. The new extinguishers feature special salt-water-resistant undercoatings and Ansul marine name plates indicating Coast Guard approval.

High-Speed Turbines

Advantages of General Electric's high-speed mechanical-drive turbines to the petroleum, chemical, and petrochemical industries are described in a new publication designated *GEA-6579*. Drive requirements for such applications as compressors, hot oil pumps, charge pumps, lift air blowers, boiler feed pumps, fire pumps, small emergency generators, and miscellaneous process pumps are detailed.

Clark Promotes Spears

Clark Bros. Co., one of the Dresser Industries, has appointed Robert J. Spears and Richard E. Jenkins as assistant general sales managers. Mr. Spears will supervise the company's eastern district offices of Boston, New York, Philadelphia, Detroit, Pittsburgh, Chicago, and Atlanta. Mr. Jenkins will supervise operations west of the Mississippi.

Mechanized Accounting Operations

Tidewater Oil Co. is mechanizing its eastern division marketing accounting operations, and will centralize them in Philadelphia by the end of the year. The move is designed to speed up the flow of statistical data and information on the sales and operations of the division. The marketing accounting systems currently being followed will be converted to an IBM punch-card operation to make informa-

tion available promptly and more frequently, V. W. Henry, division controller, has stated. Necessitating the move to centralization, Mr. Henry said, was the concentration of work required to make machine accounting efficient.

Safe Drilling Record

Believed to be one of the all-time safety drilling records in the oil industry has been set by Cecil Hampton, driller for Falcon Seaboard Rig No. 15, now operating near Lindsay in McClain Co., Okla. He has operated a rig continuously through 1953, '54, '55, '56 and '57 without a single lost-time accident to himself or his crew.

New Caltex Tanker

The 32,000 dwt turbine tankship, "Caltex Eindhoven," was launched June 19, at the shipyard of Hitachi Shipbuilding and Engineering Co., Innoshima, Japan. The vessel is scheduled to be delivered in October to NV Nederlandsche Pacific Tankvaart Maatschappij, one of the Caltex group of companies. She will increase the Caltex fleet under the Dutch flag to nine owned tankers, totaling more than 190,000 dwt. With a carrying capacity in excess of 275,000 bbl, the "Caltex Eindhoven" will have an overall length of 660 ft, a beam of 89 ft, and a loaded draft of 33 ft 10½ ins. She will be powered by steam turbines of 16,500 hp, fitted with reduction gears, and is designed to make a speed of 17 knots. She will trade mainly between the Middle East and Holland, transporting crude oil to the Caltex refinery at Pernis.

Estimates USA Productive Capacity

Productive Capacity Committee of Independent Petroleum Assn. of America has estimated productive capacity for crude-oil and natural-gas liquids from USA wells existing on January 1, 1958, at 10,373,000 b/d composed of crude-oil capacity of 9,493,000 b/d and natural-gas-liquids capacity of 880,000 b/d. USA productive capacity for all petroleum liquids increased by 273,000 b/d, or about 2.7%, during 1957, as a result of (1) exploratory and development activity; (2) continuing advances in producing and recovery technology. Actual production declined by 628,000 b/d from January 1957 to January 1958.

USA liquid petroleum productive capacity from producing wells existing on January 1, 1958 exceeded January production rate by about 2,700,000 b/d—indicating about 26% of total domestic capacity was not in use at the beginning of this year.

Assuming no significant change in economic conditions, USA productive capacity for crude-oil and natural-gas liquids from producing wells existing on January 1, 1959 is forecast at 10,550,000 b/d—9,630,000 b/d of crude and 920,000 b/d of natural-gas liquids.

SONJ Portugese Guinea Concession

Ministry of Overseas of Portugal has been authorized to conclude a contract with Esso Exploration Guine Inc. for exclusive oil exploration in Portuguese Guinea during a three-year period. Area covered is more than half the land area, and includes offshore areas—including Bijagos Archipelago. Land area lies north and northwest of a line connecting the town of Pirada and Poilao island.

The three-year term can be extended for two more years if the company has carried on intensive work—involving a first-year expenditure of at least 30 million escudos (about 1,050,000 dollars); minimum second year, 34 million escudos; and third year, 54 million.

New SSC Geophysical Tool

First Omnitape transcribing machine is now in operation at the worldwide headquarters of Seismograph Service Corp., Tulsa, Okla. Built by Hale Instruments, Houston, the machine "translates" information from various systems of seismic magnetic recording into any one of a selection of systems for uniform analysis.

According to Nelson K. Moody, manager of SSC's replay center, the new system will take seismic data recorded in one of the principal systems now in use, and record them in a uniform system so data can be coordinated in oil exploration work. Principal systems now used are Carter-Pulse Width, Techno, SIE, Direct, and SIE FM. SSC officials anticipated that further refinements in the Omnitape system should mean "translations" of seismic data into any desired and/or uniform system from all seismic tapes, regardless of method of recording.

Gerald H. Westby, president of SSC, said that the new machine would enable his company to greatly increase its service in the interpretation of data, especially in the case of multiple clients.

Kellogg Research Associate

Dr. Phillip Lefrancois has been appointed research associate by The M. W. Kellogg Co., New York. He was formerly a research chemist, and has been with the company since 1944.)

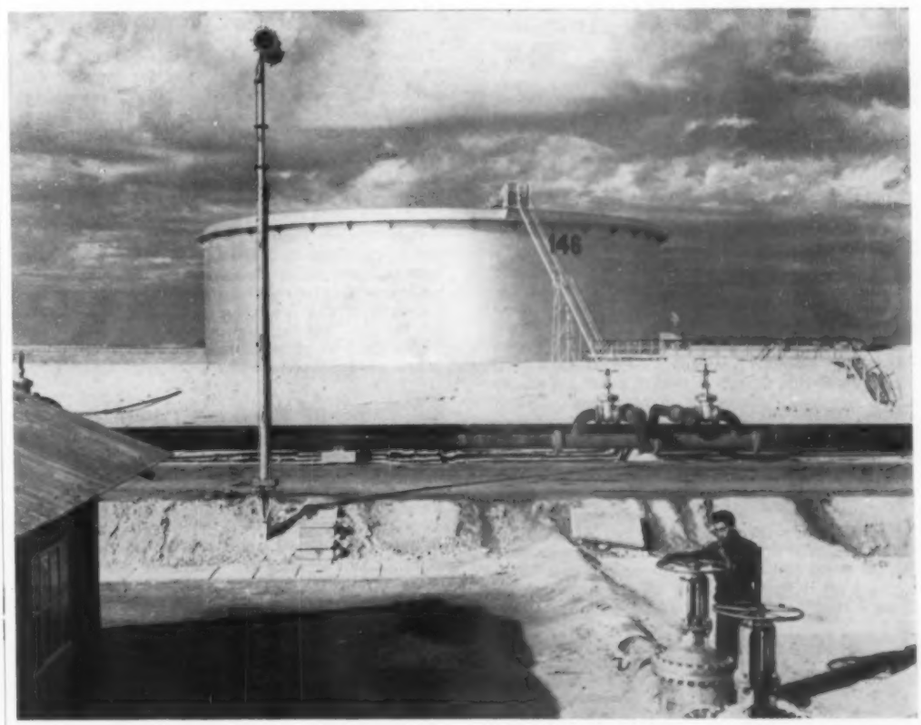
Casing Clamp

The Vise-Lok Limit Clamp developed by Halliburton Oil Well Cementing Co., Duncan, Okla., is a nonweld limiting device which sets itself tighter to casing as more load is exerted against it. Locking power results from file-hard steel teeth on four disc-shaped gripping slips which are part of a precision-forged hinged steel ring. Taper pins driven behind the disc slips force them to bite into the casing and thus anchor the clamp. The clamps are positioned so that the head end of taper pins face the equipment being held. They are used for attaching reciprocating cleaners, casing centralizers, and cement baskets to casing.

Corrosion Research Laboratory

The Carpenter Steel Co., Reading, Pa., has opened a new corrosion research laboratory which introduces new means of accurately determining the corrosion rate on all metals. It enables the company to predict more precisely the area of usefulness of stainless and other corrosion-resisting steels. In addition, it permits thorough examination of titanium, zircalloy, zirconium, and nickel-base alloys. Carpenter now can compare and pinpoint the finest differences between alloys under nearly any process condition from room temperature to 1,000 F, and from one-half atmosphere to 2,000 psi pressure.

CONTRACTORS TO THE OIL INDUSTRY



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G. L. McCoy

S. W. G. Lehman

Stanvac's New Regional VP's

Five regional vice presidents—two of whom are also members of the board—have been named by Standard-Vacuum Oil Co. to coordinate its operations in the Eastern Hemisphere. Appointments were effective July 1. Serving in a new executive category, the regional vice presidents will have overall responsibility at Stanvac's White Plains, N. Y. headquarters for the company's interests in their respective overseas regions. The new appointees, and the areas for which they will be responsible, are:

James V. Pickering, Stanvac's Far East region—including Japan, Korea, Hong Kong, Philippines, Viet Nam, Cambodia, Laos, Thailand, Malaya, and Singapore. A Stanvac director, Mr. Pickering has a background of 30 years in the company's international operations—most of it in Asian countries.

Stanley W. G. Lehman, South Asia region—including India, Pakistan, Burma, and Ceylon: A Stanvac board member, Mr. Lehman began his overseas career with the company in 1930, and has served in the Philippines, China, India, and Australia.

Gerard L. McCoy, Indonesia region: While much of Mr. McCoy's 41-year service has been in Indonesia, where the company's principal producing and refining interests are located, he also has held administrative and financial posts with affiliated companies in Mexico and New York.

Rufus T. Burton, Australia-New Zealand region—including Papua, Australian New Guinea, and the South Pacific Island: A former general manager of the company's marketing organization in South Asia, Mr. Burton's 28-year oil-industry experience also includes administrative assignments in the Philippines and New York.

Charles E. Solomon, Africa region—including Southern Africa, East Africa; and the Red Sea: Now serving as managing director of Stanvac's marketing subsidiary in southern Africa, Mr. Solomon started as a ledger clerk for that organization 30 years ago in Johannesburg. He will move to the United States to take up his new post at White Plains.

C. E. Solomon

R. T. Burton

5th World Congress Exhibits

Exhibit space is now being offered in the Fifth World Petroleum Congress Exposition. The first two floors of the New York Coliseum will be used for exhibits at the exposition, which is scheduled for June 1 to 5, 1959. The third and fourth floors will accommodate some 70 technical sessions covering sections from geology through atomic energy. Some 30,000 persons will attend.

Inquiries concerning exhibit space should be addressed to Fifth World Petroleum Congress Exposition, 480 Lexington Ave., New York 17, N. Y. E. K. Stevens is exposition manager. For those companies which may be participating in the Tulsa show, special trucking arrangements can be made to insure arrival in New York in time for installation at the coliseum. A brochure is available from the congress describing the congress.

J. V. Pickering

E. F. Liebrecht

Heads Kellogg International

E. F. Liebrecht has been elected president of Kellogg International Corp. He will continue as a vice president of the parent M. W. Kellogg Co., and will establish his office at Kellogg House, London. Mr. Liebrecht was also elected president of Société Kellogg, and will be responsible for the direction of this Kellogg subsidiary's activities in France. He has been a vice president and director of Kellogg International Corp. and a vice president of The M. W. Kellogg Co. since 1946.

Allen Heads Oil Scouts

First Canadian ever elected to the office, W. P. "Bill" Allen, Calgary, chief scout for Imperial Oil, has been named president of the National Oil Scouts and Landmen's Assn. He was elected Saturday at the organization's 35th annual meeting in Tulsa, Okla.

New Pipe Mill

Page-Hersey Tubes Ltd. has officially opened its eighth pipe and tubing mill at Welland, with the start of production at a new $5 million electric-resistance weld steel-pipe mill. The company also joined with The Steel Co. of Canada to build the $10 million "Big-Inch" steel pipe plant of Welland Tubes Ltd., which went into production early last year.

Wins BP Refinery Contract

The Lummus Co. Canada Ltd. has been appointed contractor by BP Canada Ltd. to engineer and construct the new 25,000 b/d BP refinery at Ville d'Anjou near Montreal, with planned completion in 1960. Basic process units will consist of a crude distillation unit with a total charge of 25,000 b/sd, a distillate treatment unit with a charge of 12,000 b/ds, a catalytic reforming unit with a charge of 6,000 b/sd, and catalytic cracking and polymerization unit with a fresh feed charge of 9,000 b/sd. Wharfage, pipelines, road and rail distribution facilities for products, necessary tankage, utilities, and buildings, and fire-fighting facilities are included. The refinery will be laid out in such a way as to permit future expansion double that of the original capacity.

Wins Rubber Plant Contract

Matthew Hall & Co. Ltd. has been awarded a contract for the mechanical engineering design of the synthetic-rubber plant to be constructed at Pernis refinery, Holland, for the Royal Dutch-Shell group. This will be Holland's first synthetic-rubber plant, and will have a capacity of at least 50,000 tons per annum. The decision to erect this plant has been based on extensive studies of the future world rubber requirements and supply position. Production is expected to commence in 1960. This is the second large synthetic-rubber plant contract awarded to Matthew Hall & Co. Ltd.

Nomads Hear Dr. Croneis

The beauties and mysteries of the Amazon River were discussed and illustrated by slides at the monthly Houston Nomads May meeting at the College Inn, by Dr. Corel Croneis, provost of Rice Institute and head of the geology department. Dr. Croneis took his audience on a 4,000-mile boat trip up the Amazon, and shared his knowledge both of native tribes and cultures, the oil installations and oil possibilities of the Amazon basin.

Refinery Valve Standards

Availability of *API Standard 600: Specification for Flanged and Butt-Welding-End Steel Gate and Plug Valves for Refinery Use*, has been announced by the American Petroleum Institute. This is the fourth edition, 1958. Orders should be directed to the Publications Department, American Petroleum Institute, 50 West 50th Street, New York 20, N. Y. The price is $1.50 a copy.

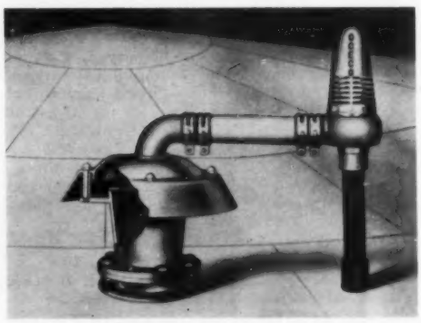
Expands Lube Facilities

Shell Oil Co. has announced a multi-million-dollar project for expansion and improvement of its lubricating-oil manufacturing facilities at Wood River, Ill. The new facilities will increase production of high-viscosity index oil to 4,000 b/d from 2,000 b/d. Construction will start this fall, the completion is scheduled for mid-1959.

Project includes construction of two new plants and expansion and improvement of the company's dewaxing and deasphalting units. In addition, truck and barge shipping facilities will be enlarged to handle increasing shipments of bulk products. The new plants are a vacuum fractionating unit and a phenol solvent-extraction plant.

First Kansas Petrochemicals

June 1 marked startup of the $3,500,000 Vickers Petroleum Co. Inc. Udex extraction plant complex—first petrochemical plant to be built by an oil company in Kansas. The plant is located at the Vickers refinery, Potwin, Kans., 35 miles northeast of Wichita. Products manufactured include benzene and toluene of reagent quality, along with xylene and solvent V-100.



Pilot-Operated Relief Valve

The Oceco Division of The Johnston & Jennings Co., Cleveland, has developed a pilot-operated relief valve for cone-roof and other low-pressure tanks, which is said to reduce tank breathing to the minimum.

The new valves do not open until the pressure setting in the tank reaches the pressure setting of the pilot, or the vacuum in the tank reaches the vacuum setting of the valve. This is unlike conventional valves which start to open at low pressure, so as to build up to full rated flow, within the safe operating pressure of the tank. The company reports that records of valves in service, on tanks, prove that these new pilot-operated valves pay for themselves in 7 to 8 months by vapor saving.

The system consists of a valve mounted on a tank, connected through a 3-in.-diameter aluminum tube to the pilot, which is also mounted on the tank. Pressure on the tank is applied against the bottom of the pilot valve—and through the tube to the large area on top the resilient membrane—keeping it tightly seated on the valve and preventing any "simmering" and "leakage" at less than set pressure.

The sensitive pilot opens full the instant the tank pressure reaches its set pressure—evacuating vapors from the top of the membrane, which opens instantly to full flow position, releasing tank pressure. The pilot closes automatically when the pressure in the tank has been released, reseating the membrane again and shutting off the flow. They are furnished in 6-, 8-, 10-, and 12-in. sizes, with low-pressure (½-oz to 8-oz) or high-pressure (½-lb to 15-lb) pilots, with either open- or closed-type valve housings.

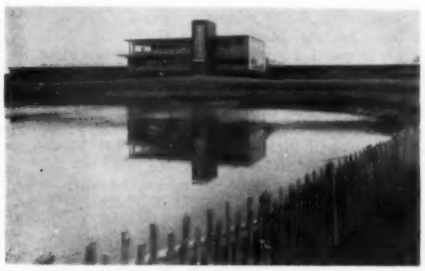
Imperial Expands Refinery

Imperial Oil Ltd. will spend more than $3 million to construct additional facilities at its Regina refinery for making high-octane gasoline. Engineering has now been completed for the installation at the refinery of a Powerformer. The project will be completed by late fall of 1959. Its capacity will be 3,000 b/d, and its output will be blended with other components to make high-octane gasoline for distribution throughout Saskatchewan.

Smokeless Refinery Flare

An oil refinery safety flare which burns with no smoke and no visible flame has been designed by Esso Research and Engineering Co., Linden, N. J., is said to eliminate smoke entirely, the new flare is part of the company's continuing campaign against air pollution. Another advantage claimed for the new flare is that the gas is burned in the base of a 38-ft stack, rather than out in the open as in conventional flares. This was done because visible flame is often misinterpreted by passersby and nearby residents to be the result of a dangerous or wasteful operation.

Esso Research said the new type of flare has proved itself during its first 16 months in use at a refinery operated by Imperial Oil Ltd., in Halifax, Canada. Its chief application will be in newly built refineries. Six such flares are planned for refineries now being built for other SONJ affiliates. Esso Standard Oil Co. a manufacturing and marketing affiliate, is studying the application of the new flaring technique to its existing refinery installations.



This is the new $2.5 million research center of The Standard Oil Co. (Ohio), Cleveland, Ohio. Located on an 87-acre tract, the new research center was designed for the orderly accommodation of the latest research equipment and to provide the best of working conditions for a staff of 125 scientists, engineers, and technicians. Manager of Sohio's research is Dr. Everett C. Hughes.

Tracers Aid Fuel Research

Esso Standard Oil Co. has redesigned its Esso Extra gasoline as a result of an extensive study of the burning characteristics of individual hydrocarbons present in previous motor fuel. Effort of the 3½-year research project was to determine which fractions caused the most engine deposits. It was found that the high-boiling-point aromatics were most harmful in their tendency not to burn clearly.

Esso research workers employed radioactive tracers to find the culprits. Individual hydrocarbon were labeled with radioactive carbon 14. The fuel then was run in the engine. At the end of the run, the concentration of radioactive material in the combustion-chamber deposit was determined.

Once it was discovered which hydrocarbons were most responsible for engine deposits, it was necessary to develop a routine test method. Efforts in this direction revealed that ultraviolet light absorption was a good measure of high-boiling aromatic content.

The Esso Extra gasoline also contains a combustion control agent which reduces surface ignition without raising spark knock requirement. With the reduction or elimination of high-boiling aromatics and the new additive, Esso has found that octane requirements of most cars are lower. Cars with an octane requirement of 101 may need a fuel of only 98 with the new agent.

The Esso research program just completed involved more than a million miles of road tests and cost $750,000.

TEL Action Explained

New clues on how tetraethyl lead prevents knock were offered by E. B. Rifkin, of Ethyl Corp., at the recent mid-year meeting of the API refining division. TEL becomes active only after it has broken down inside the engine into tiny particles of lead oxide, Mr. Rifkin said. Research findings suggest the real antiknock action may be removal of active oxygen from products of fuel oxidation in the engine.

Mr. Rifkin's theory supposes that the oxygen-removal reaction occurs on the surface of yellow lead-oxide particles, converting them to red-lead oxide. If the lead-oxide particles are attacked by fuel impurities, they may be converted to non-active compounds. This would explain why sulfur compounds and other antiknock antagonists reduce the action of tetraethyl lead. Factors controlling antiknock action include the size of the lead-oxide particles, the composition of the particle surfaces, and the ability of reactive substances in the fuel-air mixture to reach these surfaces.

Socal Refinery Expansion

Standard Oil Co. of California, Western Operations Inc., will expand its refinery at Richmond, Calif., by a 40,000 b/d fluid catalytic cracker. Project will get under way immediately, with completion scheduled for the summer of 1959.

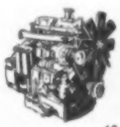
Wins Four Contracts

Badger-Comprimo NV, The Hague, has been awarded contracts with a total value of $2,800,000 for the design, engineering, and construction of three chemical plants and an asphalt-production unit. Two will be in England, and the third chemical plant in Germany. The asphalt plant is for Esso Belgium.

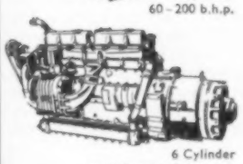
SPECIFY

ROLLS-ROYCE Diesels

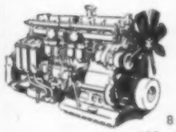
The suitability of Rolls-Royce diesels for a wide variety of installations is proved by the fact that a dozen of the world's leading Oil Companies in South America, Trinidad, Iraq, Kuwait, and Borneo are placing orders for Rolls-Royce powered equipment. National Oweco and Woodfield Hoist Ideco are using Rolls-Royce diesels in work-over hoists, service drilling rigs and slush pumps. On Lake Maracaibo Shell are operating over seventy Rolls-Royce diesels in high speed launches and workboats, in addition to a large number in Coles Cranes, Consolidated Pneumatic Compressors, Scammell Trucks and Petbow Generators.



4 Cylinder
60 - 200 b.h.p.



6 Cylinder
with Torque Converter
80 - 300 b.h.p.



8 Cylinder
100 - 400 b.h.p.

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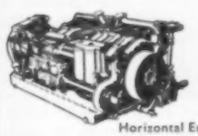
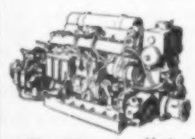
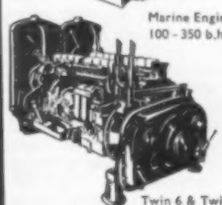


Horizontal Engines
100 - 400 b.h.p.



Marine Engines
100 - 350 b.h.p.



Twin 6 & Twin 8
Power Packs up to 600 b.h.p.

INTERNATIONAL NEWS AND NOTES

Portuguese Refining Up

Production of oil products from the refinery of the Sociedade Anonima Concessionairia da Refinacao de Petroleos, Lisbon, Portugal, passed one million tons last year for the first time. The total was 1,032,606 metric tons (about 21,000 b/d). Capacity of the plant now is about 24,000 b/d—to be increased to 30,000 b/d as part of a six-year development plan which calls for spending 180 million escudos for refinery expansion. SACOR reported net profits after taxes last year of 98,497,595 escudos.

SOPONATA. the consortium of shipowners, in which SACOR holds 25% of capital, increased size of its fleet last year to 120,000 tons, with addition of the tanker "Erati" of 17,000 tons. The company has two tankers under construction—one the Fogo, of 27,000 tons, which is to enter service in August; and the other, a 40,000-ton Japanese-built vessel, which is to be ready March 1960.

Abadan Fire Accident

Officials are convinced the fire at the Abadan refinery tank farm, April 11-13, where 40 were injured, was accidental. Cause may never be known, but it is believed due to static electricity from equipment used by a laborer in measuring the level of the tank. Among those injured was Paul E. Kuhl, general refinery manager. A fire at Ahwaz well No. 6, April 19, was regarded as a coincidence.

Russia's Oil Wealth

Mr. Khrushchev's forecast of crude production, as reported in "International News & Notes," March 1958, has been followed by some significant statements by the USSR Minister of Geology, P. Antropov. The earlier prophesy that production of crude was to be raised to between 350 and 400 million tons in 1972 from 98 million in 1957, and natural-gas production to between 270,000 and 320,000 million cubic meters over the same period (from about 21,000), has been endorsed by Mr. Antropov, except that this would be achieved only by determined exploration in many parts of the vast USSR territory.

So far, most of the oil comes from two areas only: Ural-Volga, with more than 100 fields established and 68 in operation; and Azerbaidjan (with Baku). Eastern USSR, where much of the new industrial development is taking place, had not yet been thoroughly investigated for potential oil wealth. but the minister has stated authoritatively there are indications of vast oil and gas reserves in these parts, notably in Siberia. Mr. Antropov is confident large oil and gas discoveries will be made in the near future in the West Siberian lowlands, to the east of the Ural mountains. Substantial reserves have already been found in this part of Siberia, as well as farther east in the Lena-Vilyuysk depression. The minister also was optimistic about potentialities at Kazakhstan (large territory south of Siberia), the Irkutsk region (near Lake Baykal, and the Soviet Far East.

Without definite figures, Mr. Antropov claimed the USSR is among the world's richest countries in proved oil reserves and other minerals.

Rising crude output also is of importance to the USSR aid program to underdeveloped countries. Assistance also is to be given for oil in prospecting. Egyptian trade is being increasingly reorientated towards the Soviet bloc, and her oil imports now come entirely from Russian and Romanian sources.

Japanese Rubber Plant

The Japanese Synthetic Rubber Co. Ltd., organized recently for the purpose of establishing a synthetic-rubber industry in Japan, has been licensed to construct a Houdry dehydrogenation process unit to produce 25,000 tons per year of butadiene. Unit will be part of an integrated synthetic-rubber plant to be built in the Yokkaichi vicinity. When supplemented by other butadiene sources, the plant will produce 45,000 metric tons per year of synthetic rubber. Refinery butanes and butane-buten mixtures from petrochemical plants will be charged to this unit on completion—planned for 1960.

India Oil Drilling

The Natural Gas and Oil Commission of India is shortly to undertake drilling in three areas apart from Jwalamukhi, where operations began just over a year ago. The first two on the list of approved sites are Hoshiapur in Punjab, and Cambay on the west coast. The Sibsagar area of Assam is also a promising region. For the Hoshiarpur project, drilling will have to pierce 8,000 ft to 9,000 ft at a cost of $945,000 to $1,050,000 per well. Geological mapping has indicated an anticline which is the most favorable structure for oil. The Cambay site is about a mile from the sea, and work here will begin after the Hoshiarpur project is in full swing.

Other promising oil sites are the Janauri area in Hoshiarpur District, Jaisalmer in Rajasthan, and the Madras coast. Janauri is expected to be taken in hand after drilling starts at Sibsagar.

Crude Lines For North Italy

Three projects for pipeline construction in North Italy are being examined by Italian central authorities. The projects are: one 180-km crude line from Multedo (near Genoa) to Stabio (Switzerland) where a new refinery is considered. The project has been submitted by the Petrol Pegli SpA, of Genoa.

Compagnia Trasporti Petrolio, of Milan, plans a crude line from Multedo to S. Giuliano Vecchio and to Locate Triulzi (both in the Po valley, south of Milan) where inland storage of crude facilities will be located.

SIMSA is considering installation of crude terminal (crude capacity 300,000 cubic meters) in the hinterland of Multedo. Terminal will be connected to the oil docks by crude pipelines.

A large share of the crude being unloaded at the oil docks of Genoa and at the oil harbor of Multedo is still being forwarded to the inland refineries by railroad and highway. Increasing traffic on the Genoa-Po valley rail and highway system encourages laying of crude lines. Two long-distance crude lines have been in existence since 1951, connecting the seashore to the inland refineries at San Martino di Trecate (SARPOM) and at Rho (Condor).

Delhi Enters Australia

Delhi Australian Petroleum Ltd., a wholly-owned subsidiary of Delhi-Taylor Oil Corp., has entered into an agreement with Santos Ltd. to explore for oil and gas in Australia. Santos holds exploration licenses covering 267,000 sq mi in the states of Queensland and South Australia. Delhi Australian has agreed to drill a stratigraphic test well and conduct certain other exploration activities in order to acquire ½ of Santo's interest.

280-Ft Tall Discharge In Italy

A new 280-ft chimney, by Dalmine of Milan, has been set up at the Italia refinery in Cremona. It is the tallest chimney of this kind existing in Europe, and its extraordinary height is due to the fact that the owners of the refinery wish to avoid any contamination of air near the town of Cremona.

The 280-ft tall chimney is made of seamless-steel pipe. It consists of six joints, each of which is a little thinner than that below it. The welding of separate pieces was done end to end. Basic electrodes were used, and the parts welded were preheated to 300 C.

At the top of the chimney there is a tiny platform which can be reached by means of a permanent ladder, interrupted by four little platforms for rest. The lower extremity of the steel pipe is sunk 11½ ft into concrete foundations. Total weight of the chimney exceeds 16 tons. It will withstand wind blowing over 80 miles an hour.

Iraq Plans Offshore Terminal

The Iraqi Prime Minister, Nuri Al-Said, has made a government policy statement on territorial waters to pave the way for the building of a £30 million (sterling) deep-water oil terminal at the mouth of the Persian Gulf. The terminal, to be built by the Basrah Petroleum Co. Ltd., will be capable of receiving tankers of more than 100,000 tons, and is expected to be completed by 1960. The prime minister said that "full sovereignity" extended to Iraq's territorial waters, its air cover, the sea-bed and below the sea-bed Iraq would not recognize any dispute by any neighboring country regarding the territorial waters or its contiguous zone. The cost of the terminal will be added to the capital expenditure of the oil companies operating in Iraq, and will be refunded by the Iraq government and the oil companies on a 50-50 basis in 20 annual installments. Iraq, last year, announced its decision to embark on exploration in its contiguous zone inside the Persian Gulf.

France's Consumption

France's long-standing interest in North Africa has been enhanced by discovery of major oil resources in the Sahara, from which first oil consignment was shipped early this year.

Potential value of this to her economy is indicated by figures of French consumption of oil products in 1957, which have just been published. Despite temporary restrictions caused by the Suez incident, total internal demand was about 352,000 b/d—only fractionally lower than in 1956, and over three times 1947 consumption of 100,590 b/d. Much the most promising item in last year's returns was fuel oil, with 185,040 b/d—more than 52% of all products. Motor spirit accounted for a further 87,360 b/d. Other leaders were gas oil (28,700 b/d); bitumen (19,560 b/d); and propane, butane, and etc. (11,680 b/d). In addition to internal requirements, bunkers for shipping absorbed a further 33,670 b/d of heavy oils.

Large New Refinery In Sicily

President of Sicily recently signed a decree authorizing Societa' Mediterranea Raffineria Siciliana Petroli to build a large petroleum refinery close to Milazzo, on the northeastern coast of Sicily—with capacity of about 52,000 b/d—eventually to be expanded to 100,000 b/d. Refinery will have plants permitting a complete cycle of processing; products turned out will include fuel oil, gas oil, kerosine, gasoline, and jet fuels, LPGAS, etc.

The new refinery will be connected with submarine pipelines to permit unloading directly from tankers and rapid loading of processed products. Depth of the sea at Milazzo is such as to permit even 100,000-ton tankers to come quite close to shore.

Refinery will process crude from the Middle East, and export most of its output to other countries.

German Gas Price Threatened

Retail gasoline prices in West Germany are shaky, as independent dealers and wholesalers bring in hydrogenated gasoline from the Soviet zone and surplus gasoline from Italian refineries which are subsidized. Further, Caltex and Purfina have been cutting prices as they seek footholds in the market. The companies do not operate their own retail outlets.

Japan Petrochemical Expansion

The petrochemical industry in Japan is expected to make headway in 1958, with four large companies scheduled to begin production.

The Mitsui Petrochemical Industry's new plant at Iwakuni, in Yamaguchi prefecture, is almost completed, and will soon start test operations.

Three other companies—Mitsubishi Oil, Sumitomo Chemical, and Maruzen Oil—are expected to build new installations this year.

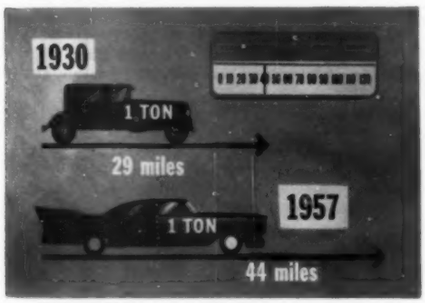
The Maruzen Oil and the Japan Petrochemical companies have already started output on a small scale, but the completion plants of other enterprises had to be deferred until this year due to the tight money situation.

Asphalt Plant Moved To Sicily

Lube and asphalt plant of the SARN (ENI group) at Novara, North Italy—shutdown for more than a year—is being moved to Gela (Sicily) near the oil field discovered by AGIP-Mineraria two years ago. The plant will be close to Gela harbor and connected to the field through three pipelines—one for gas oil. Gela's low-gravity (7 API) high-viscosity crude will be shipped to the plant diluted with gas oil. Four wells are producing, and five more are being drilled.

Ethyl Studies Gasoline Values

The average car on the road today gets 70% more ton-miles out of a gallon of gasoline, and at 18% less cost exclusive of taxes, than did its counterpart in 1930, according to an extensive study of gasoline value recently completed by Ethyl Corp. Approximately 35 billion gallons of gasoline, and over 1½ billion barrels of crude petroleum, are conserved each year as a result of the improvement in fuels and engines, it is pointed out. In terms of the average motorist, Ethyl's study showed that, without these improvements, the typical car owner today would need an additional 475 gal of gasoline a year to drive today's average mileages. At current prices, this means a saving of over $140 a year on his gasoline costs.



One of Ethyl's photos showing the great increase in real mileage which motorists enjoy today, as a result of the dramatic improvement in gasoline and engines over the years. At a cruising speed of 40 mph, one gallon of 1930 gasoline could move a ton of 1930 automobile an average distance of 29 miles. Twenty-seven years later, a gallon of modern gasoline could move a ton of 1957 automobile a distance of 44 miles—a gain of 52%. For the average car on the road in 1930 and today, the ton-miles per gallon have increased to 43 ton-miles today, from 25 ton-miles in 1930, for an improvement of 70%.

New Series, Refining Chemistry

First volume in a new series on advances in petroleum chemistry and refining has been published under the editorship of two chemical engineering professors at The University of Texas. With an advisory board of 16 prominent oil-company scientists and international consultants, Dr. Kenneth A. Kobe and Dr. John J. Mcketta, Jr., at annual intervals will present a collection of progress reports written by leading authorities on particular subjects, blueprinted under the following five divisions: economics and future trends; unit operations and design; refining processes; petrochemicals; and mechanical equipment.

The 21 authors in Vol. I have contributed chapters to the five divisions on the following general topics: (1) Petroleum operations in the USA; present and future sources and compositions; fuel trends. (2) Separation and purification by crystallization; superfractionation, azeotropic and extractive distillations; new fractionating-tray designs. (3) Alkylation of paraffins; catalytic reforming; solvent refining. (4) The Oxo process; solid polymers from surface catalysts. (5) Power plants of the future.

ADVANCES IN PETROLEUM CHEMISTRY AND REFINING, Vol. I; cloth; 642 pages; halftones, tables, and charts; index; available from publishers, Interscience Publishers Inc., New York (1958); $13.50.

New 1,500 B/D Asphalt Plant

Imperial Oil Ltd. will build an asphalt plant at its Edmonton refinery at a cost of $1.4 million to meet growing demand for roofing and paving materials in northern Alberta and northeastern British Columbia. The plant will have capacity of 1,500 b/d.

Canada's Runs Up 4% in 1958

Despite substantial cuts in first-quarter operations from same period of 1957, Canadian refiners estimate 1958 runs will increase by 4% over 1957, at 248 million barrels compared to 238 million last year. Canadian refining market for domestic crude will gain by 12 million barrels, to 140 million; while imports decline by 2 million, to 108 million.

Houdriformer For Michigan

A new 1,150 b/d Houdriformer has been placed in operation at West Branch, Mich., by West Branch Refineries Inc., a subsidiary of Osceola Refining Co. Inc., Reed City, Mich.—for production of high-octane fuels from Canadian and Michigan naphthas. Process engineering was by Houdry; engineering by Litwin Engineering Co.

New D-X Sunray Refinery Units

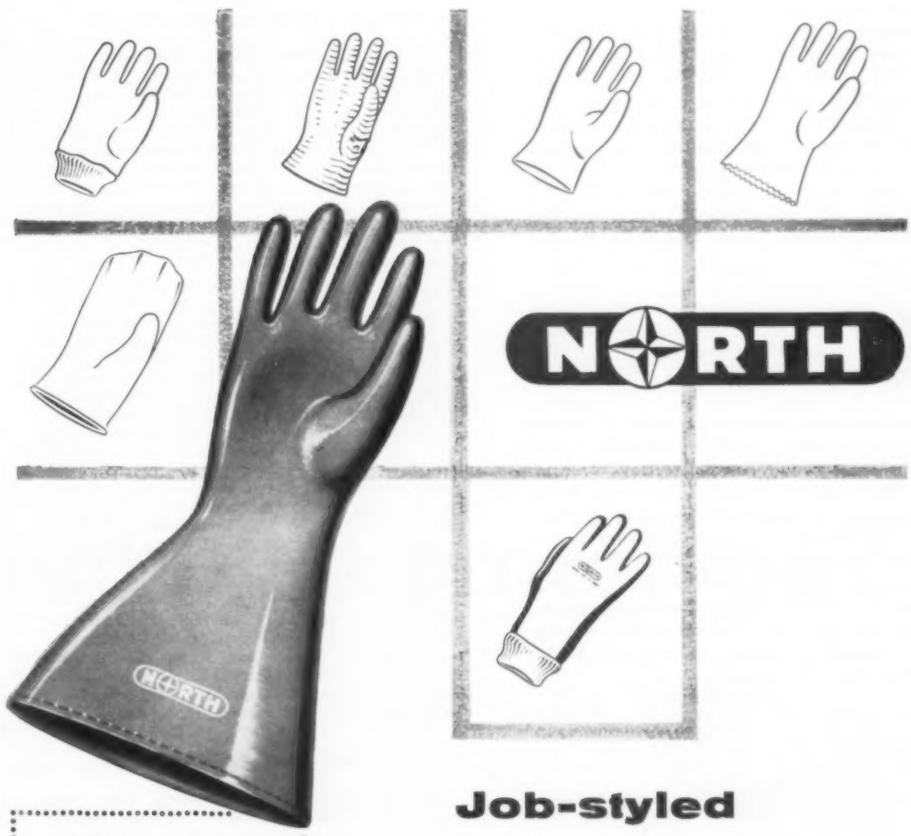
The 75,000 b/d D-X Sunray plant at Tulsa, Okla., has added four new processing units costing $12 million, but didn't increase its output. Entire project is for quality, not quantity, according to Harry A. Brown, manufacturing vice president. The new units include a 20,000-bbl naphtha Unifiner; 12,000-bbl Platformer; 2,400-bbl butane isomerization unit; 2,500-bbl hydrofluoric-acid alkylation unit.

New Polyethylene Rope

A new synthetic fiber fits requirements of rope users everywhere for a wide variety of applications. Leading companies are producing the rope from Phillips Marlex yarn. Among the new rope's features are: It floats; is 75% stronger; waterproof; impervious to rot; and has high electrical resistance.

Japan's First Udex Unit

The first Udex installation in Japan went on stream recently at the refinery of Mitsubishi Oil Co. Ltd., marking the entrance of this firm into the petrochemical field. Startup of this unit, which has a design capacity of 750 b/sd to produce benzene, toluene, and xylenes, followed by less than two weeks the placing into operation of a second UOP Platforming unit at the Mitsubishi plant.



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Petrochemical Horizons

(Continued from page 97)

operating temperature is determined by catalyst activity; it is normally between 300 C and 400 C. Means must be provided to supply the heat requirements (15,900 cal. per gram-mole at 327 C) of the endothermic dehydrogenation reaction.

Information has become available on operations in one commercial plant for the dehydrogenation of isopropanol. At this plant, the catalyst is 7% to 8% zinc oxide on pumice. It is mounted in the tubes of a shell-and-tube reactor. Heat of reaction is supplied by flue gas, which is circulated through the reactor shell at carefully controlled temperature.

Isopropanol in the feed gas is joined by an equimolar quantity of hydrogen. The purpose of such hydrogen addition is to suppress catalyst-fouling polymerization reactions. This measure may be taken without seriously lowering the possible conversion, since the reaction equilibrium is highly favorable to acetone formation at 380 C, the average operating temperature at the plant under discussion.

With fresh catalyst, conversion of 98% is attained in single-pass operation. The product is almost entirely acetone, accompanied by only minor formation of propylene and diisopropyl ether.

In the course of its onstream life, catalyst activity drops, and regeneration becomes necessary after about 10 days. Such reactivation is accomplished by burning the catalyst-fouling deposit in a 2% oxygen-98% nitrogen atmosphere at 500 C. About 20 regeneration cycles are possible before the catalyst must be replaced.

The recovery of acetone from the dehydrogenation reactor gas is fairly straightforward. The effluent stream is water-cooled and condensed. Residual gas is water-scrubbed. The combined washings and condensate are subjected to standard fractionation and azeotropic distillation for recovery of commercial-grade acetone and anhydrous isopropyl alcohol.

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Part II will appear in an early issue. End

Japanese Houdriformer Onstream

A 3,000 b/d Houdriformer has gone onstream at Yokkaichi refinery of the Daikyo Oil Co. Ltd., of Tokyo—for production of high-octane gasoline from the high-paraffin high-sulfur naphthas derived from the Middle East crudes processed by the Yokkaichi refinery. Houdry furnished process design; engineering by both Houdry and Refinery Engineering Co., Tulsa, Okla.; and construction by Daikyo.

Heads Project Engineering

The M. W. Kellogg Co., N. Y. has appointed H. P. Wickham as manager of a newly formed project engineering department which combines the operating division with project engineering. Mr. Wickham was formerly manager of operating division, process dept.

Ethyl Opens S. F. Plant

Ethyl Corp.'s new Pacific Coast plant, located at Pittsburg, Calif., in the San Francisco Bay area, officially went into production, June 2. Glenn O. Hayes, general manager of manufacturing, said the local plant represents the latest step in a $125 million plant expansion and improvement program carried out by Ethyl Corp. in recent years.

Clark O&R Refining Units

Clark Oil & Refining Corp. has announced the startup of new refining facilities which are part of a $7,250,000 expansion program carried out at the company's refinery at Blue Island, Ill. The new facilities include a 12,500 b/sd fluid catalytic cracking unit and a 1,500 b/sd "HF" alkylation unit—both designed and licensed by Universal Oil Products Co. Procon Inc. built the cat cracker—one of the largest in the Chicago area—as well as attendant gas-concentration facilities.

World Congress Policy Group

The key scientific problems facing the oil industry were reviewed by the Permanent Council of the World Petroleum Congress at a meeting in Vienna, Austria, June 18 and 19. According to E. V. Murphree, president of Esso Research and Engineering Co., and chairman of the council, a policy-making group from technical societies in 11 nations, purpose of the meeting was to decide on the topics to be discussed in technical reports at the Fifth World Petroleum Congress to be held in New York, N. Y., May 30 to June 5, 1959.

Under consideration by the council are some 250 scientific studies on the progress being made in various phases of the oil industry. They include means of developing new products from oil—particularly fuels, plastics, and synthetic rubbers and fibers. Other general areas of top technological importance and techniques for finding new ways to discover and assess additional oil reserves and methods for recovering more oil from existing fields.

Some sessions of the congress will also be devoted to the role of nuclear energy in the petroleum industry.

Members of the permanent council are: *Austria*, Dr. H. Kupper, Dr. G. Waldschutz; *Belgium*, C. Bonami, Prof. P. V. Ch. Ercullisse, Prof. F. P. Malschaert; *Canada*, Dr. G. W. Gurd; *France*, R. Navarre, Prof. H. Weiss, S. Scheer; *Germany*, G. Schlicht, Dr. E. H. A. Bentz, Dr. K. Ziegler; *Great Britain*, Sir Stephen Gibson, Dr. E. B. Evans, Colonel S. J. M. Aud; *Holland*, Dr. I. H. Ter Meulen, J. A. Beukers; *Italy*, Prof. C. Padovani, Prof. G. Roberti, T. Salvadori; *Mexico*, Don Antonio J. Bermudez; *United States*, E. V. Murphree, J. McAfee, H. B. Nichols; *Venezuela*, Dr. Carlos Perez de la Cova; *General Secretary*, D. A. Hough.

Udex Unit Economics

Data on Universal Oil Products Co.'s Udex process for solvent extraction of benzene, toluene, and xylenes from refinery streams or coke-oven light oil are summarized in a new booklet issued by the company. Included are statistics on aromatics production trends, a flow sheet, photos of equipment and instrumentation, plus data on yields, estimated chemical and utility requirements, and operating cost estimates.

Refinery and petrochemical engineers can obtain copies of the booklet by writing to Universal Oil Products Co., 30 Algonquin Road, Des Plaines, Ill.

Westinghouse Appointments

A. B. McCloskey, formerly vice president in charge of general area sales, has been made vice president-marketing for Westinghouse Electric International Co. R. L. Jeans, formerly vice president in charge of general apparatus sales, has been appointed vice president-products. Both will report to J. de Cubas, executive vice president.

Tretolite Staff Changes

Recent additions to Tretolite Co.'s staff of field engineers include: Conrad P. Lozano, Odessa, Texas; Frank J. Ortt, Estevan, Saskatchewan, Canada; James H. Roberson, Jr., Casper, Wyo.; Robert E. Morgan, El Campo, Texas. Wayne L. Brown, El Dorado, Kans., has been transferred to Anaco, Venezuela. LaVern L. Trompke has been named field service engineer at Kimball, Nebr.; Norman J. Ruder has been assigned to Plainville, Kans.; James H. Turner to New Iberia, La.; and Leigh L. Slade to Odessa, Texas.

Warren Executive Changes

C. E. Wharton, vice president for Warren Petroleum Corp.'s manufacturing division since 1956, retired as of July 1. He has been succeeded by C. W. Miller. J. R. Sherman becomes assistant manager of the division. Both are located at Tulsa, Okla.

A native Iowan, with a chemical engineering degree from Iowa State College, Mr. Miller joined the former Hanlon companies early in 1934. In 1955 he went to Warren's headquarters in Tulsa; was named assistant manager of the manufacturing division a year later, and advanced to manager in 1957.

Mr. Sherman, a native Pennsylvanian and Chemical engineering graduate of Houston University, started with Gulf Oil Corp. in 1938. When Gulf assigned its natural-gasoline plants and personnel to Warren Petroleum, he was named area manager and supervisor of the former Gulf natural-gasoline plants.

Heat-Transfer Symposium

Thirty technical papers and a manufacturer's exhibit will be features of the Second Annual Heat Transfer Conference at the Edgewater Beach Hotel, Chicago, August 18-20. The conference is sponsored by the American Inst. of Chemical Engineers and the American Socy. of Mechanical Engineers. The exhibit, in which a score of manufacturers will participate, will show the latest in heat-transfer equipment, media, and ancillaries.

Ethylene Plants Onstream In Japan

Two major ethylene plants designed by Stone & Webster Engineering Corp. have gone onstream in Japan. A 20,000-metric-ton-per-year unit for Mitsui Petrochemical Industries Ltd. is located at Iwakuni City, near Hiroshima, Japan. The other ethylene plant is a 12,000-metric-ton-per-year unit for Sumitomo Chemical Co. Ltd., located at Niihama on the island of Shikoku, south of Japan's Inland Sea.

The Mitsui ethylene plant obtains its feed stock from a nearby refinery, and the other ethylene product is used for making polyethylene by the Ziegler process.

The Sumitomo ethylene also is used for the production of polyethylene by the Imperial Chemical Industries Ltd. high-pressure process. A phenol and acetone plant which Stone & Webster also designed for Mitsui Petrochemical is expected to go onstream at Iwakuni City shortly. These plants are among eight petrochemical plants in Japan either recently completed or presently under design by Stone & Webster engineers.

Cool Flame Oxidation

R. E. Ferguson and C. R. Yokley of the US Bureau of Standards, have prepared a report on the "Separation of the Products of Cool Flame Oxidation of Propane," which was written as a result of research on the chemical properties of fuels. The method of separation employs a combined gas-liquid, gas-solid chromatographic technique which is specifically adapted for isolating oxidation products of propane-2-C^{13}. This tracer compound, containing the C^{13} isotope in the middle position, is used to follow the course of the reaction and reaction products. Study of the separated oxidation products is expected to provide fundamental data on the mechanism of autoignition in hydrocarbon-air mixtures.

The procedure for separating and identifying the components from very small amounts of the product mixture incorporates the following basic techniques: use of isotopic tracer methods, gas chromatography, low-temperature distillation, and mass spectrometry. For the overall process, the oxidized gaseous mixture is separated by low-temperature distillation into four large fractions (according to temperature); the fractions are separated into in-

dividual compounds in the appropriate chromatographic column; and then each compound is analyzed using mass spectrometry.

Several dry runs with ordinary propane were successfully completed before actual isotopic studies were attempted. Since then, three complete series have been run; and about 20 major isotopic products, some present in less than 0.1 cc amounts, have been obtained from the analysis. Final interpretation of the results of the tracer experiments is now in progress.

Ohio Cited for Safety

A perfect safety record for 1957 at The Ohio Oil Co.'s Research Center, Denver, Colo., has won a top commendation from the National Safety Council. The center went nearly 140,000 man-hours without a lost-time accident. According to the safety council, perfect records in petroleum research are very rare.

Sinclair Refinery Discontinued

Sinclair Refining Co. is discontinuing its Wellsville, N. Y., refinery operations. The plant was primarily designed for the processing of Pennsylvania grade crude oil, and is the company's smallest refining unit. Rated capacity is 10,000 b/d, but the progressively diminishing availability of Pennsylvania grade crude has reduced the current supply through existing facilities to a daily average of approximately 3,500 bbl.

A recent fire which seriously damaged one of the main processing units precludes the supplementing of the crude supply with crudes from other sources. This circumstance has made shutdown imperative.

SOHIO Alkylation Unit Onstream

The new $3.4 million alkylation unit at the Cleveland No. 1 refinery of The Standard Oil Co. (Ohio) was scheduled to go onstream April 28. New unit, built by Arthur G. McKee & Co., of Cleveland, will have a daily capacity of 150,000 gal of high-octane gasoline components.

New Pipeline Construction Co.

Sadler Brothers Pipeline Construction Co. has been organized to operate throughout the Mid-Continent area, and will specialize in construction of main lines, road and river crossings, oil and gas gathering systems, border stations, and meter installations. Partners in the venture are Vernon L. Sadler, Drumright; Roy E. Cook and Leo F. Sadler.

Fire Protection

"Special Hazard Fire Protection" is the title of a booklet prepared by Grinnel Co., Providence, R.I. The booklet discusses recognition of special hazards and various methods of protection, including water sprays, foam, CO_2, dry chemicals—with a quick selector chart to aid in determining which methods should be employed.

New Atlantic H_2SO_4 Alkylate Unit

The Atlantic Refining Co. has announced completion of a new 2,100 b/d sulfuric-acid alkylation unit at its Atreco refinery, Port Arthur, Texas. Designed and constructed by The Fluor Corp. Ltd., of Houston, the new unit will produce high-octane blending components for the company's Imperial gasoline. Feed stock for the new equipment will be furnished from a catalytic cracking unit and two catformers—one of which was completed last fall. Although total output of the refinery will not be increased, a greater proportion of high-octane gasoline will be produced.

New Log Data

West Texas Electrical Log Service, of Midland, Texas, has announced publication of the 1958 edition of West Texas Electrical Log Service catalog. This book contains a compilation of all electrical and radioactivity logs released to the oil industry from January 28, 1957 through January 27, 1958, by counties, by fields, and by wildcat and development wells covering the West Texas and New Mexico area.

Willys Promotions

L. K. Covelle, Jr., and J. C. Delaplain will assume new duties and responsibilities in an overseas expansion program now under way at Willys-Overland Export Corp.

Plastics Polymers Book

Linear Polyethylene and Polypropylene—Problems and Opportunities has been published as the first comprehensive report for businessmen on the rapidly expanding field of high-density plastics polymers. Written by nine graduates of Harvard Business School, the 168-page report is available in a limited edition from Polymer Associates, 6613 Wenonga Road, Kansas City, Mo.; price $13.50.

New ASTM Manual

MANUAL ON MEASUREMENT AND SAMPLING OF PETROLEUM AND PETROLEUM PRODUCTS presents under one cover available information for measuring quantities of pretroleum and its products, and for obtaining representative samples thereof. This, the third edition of the manual, contains the ASTM methods required to measure and compute the quantity of oil in storage and transportation tanks of various types, and for obtaining typical samples of the tank contents.

Copies of the book may be obtained from Am. Socy. for Testing Materials, 1916 Race St., Philadelphia, 3, Pa. at $3.50 each.

Sunset to Acquire McRae

Sunset International Petroleum Corp., Beverly Hills, Calif., plans to acquire McRae Oil and Gas Corp., of Denver. J. A. McRae is slated to become a vice president and director of Sunset.

The McRae acquisition will extend Sunset's operations to seven additional states in the Rocky Mountains, Texas, and Mid Continent areas. Sunset will acquire approximately 86,000 net acres. When the merger is completed, Sunset's net oil production will be about 4,000 b/d; net gas 8 mmcf per day.

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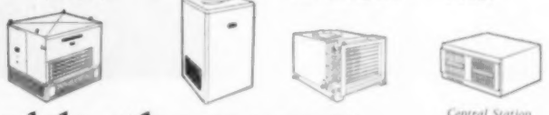

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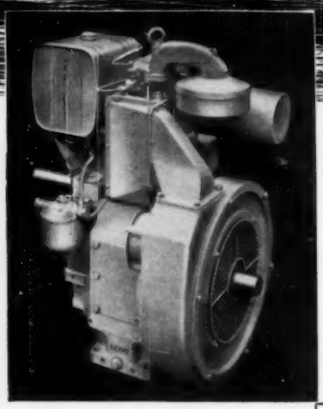

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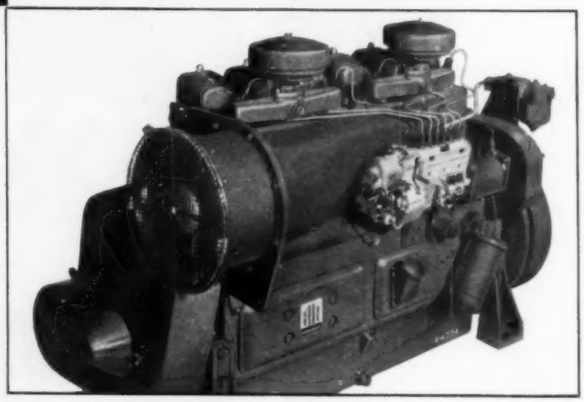

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